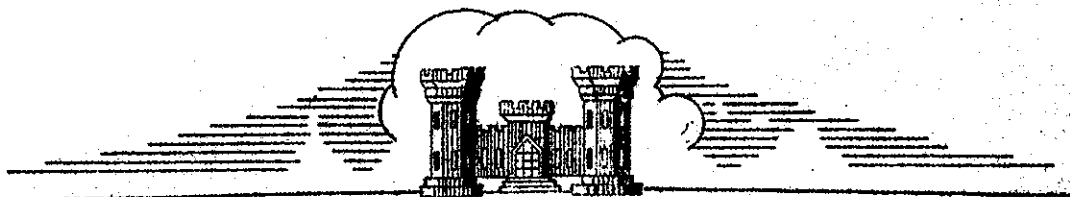


CONNECTICUT RIVER FLOOD CONTROL PROJECT

**SURRY MOUNTAIN DAM**  
ASHUELOT RIVER, NEW HAMPSHIRE

**SPECIFICATIONS**  
FOR  
**CONSTRUCTION OF DAM**  
AND  
**APPURTENANT STRUCTURES**



WAR DEPARTMENT, CORPS OF ENGINEERS, U. S. ARMY

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

457 2 2

CONNECTICUT RIVER FLOOD CONTROL PROJECT

SPECIFICATIONS  
FOR CONSTRUCTION OF  
SURRY MOUNTAIN DAM  
ASHUELOT RIVER  
NEW HAMPSHIRE  
1939

CORPS OF ENGINEERS, U. S. ARMY

U. S. ENGINEER OFFICE

PROVIDENCE, R. I.

(Specifications originally prepared as of  
December 30, 1938. Revised and issued  
under date of June 20, 1939.)

No. \_\_\_\_\_ Bidder \_\_\_\_\_

Invitation No. 699-39-362

(Do not write above this line)

STANDARD GOVERNMENT FORM OF INVITATION FOR BIDS  
(Construction Contract)

War Department  
United States Engineer Office  
Providence, R. I.  
June 20, 1939

SEALED BIDS, in duplicate, subject to the conditions contained herein, will be received until 2 p.m., Eastern Daylight Saving Time, July 21, 1939, and then publicly opened, for furnishing all plant, labor and materials and performing all work for the construction of Surry Mountain Dam, located on the Ashuelot River near Surry, New Hampshire.

I. THE WORK shall be in strict accordance with the specifications, bidding schedule and drawings designated as follows:

Specifications for Constructing Surry Mountain Dam on the Ashuelot River, New Hampshire.

The drawings which will become a part of this contract are designated in Paragraph 1-04 of the Specifications. Where copies of drawings are requested a deposit of \$10.00 will be required to insure their return. This deposit should be in the form of a United States money order or a certified check, made payable to "The Disbursing Officer, U. S. Engineer Office, Providence, Rhode Island."

II. GUARANTEE will be required with each bid as follows: Bid bond, Standard Form No. 24, will be executed in a penal sum approximately equal to and not less than ten (10) per cent of the total amount of the bid. Individual sureties will justify in sums aggregating not less than double the penalty of the bid bond. (See Paragraphs 8 - 11, inclusive, of Instructions to Bidders.) Certified check may be furnished in lieu of bid bond.

III. PERFORMANCE AND PAYMENT BONDS will be required from the successful bidder as follows:

a. A performance bond with good and sufficient surety or sureties, for the protection of the United States, Standard Form No. 25, will be executed in a penal sum approximately equal to and not less than fifty (50) per cent of the full amount of the consideration of the contract.

b. If the consideration of the contract will exceed \$2,000.00

in amount, but will not be more than one million dollars (\$1,000,000.00), a payment bond with good and sufficient surety or sureties, for the protection of persons furnishing material and labor for the work, Standard Form No. 25-A, will be executed in a penal sum approximately equal to and not less than fifty (50) per cent of the full amount of the consideration of the contract; forty (40) per cent where the contract exceeds one million dollars (\$1,000,000.00) but is not more than five million dollars (\$5,000,000.00); and two million five hundred thousand dollars (\$2,500,000.00) for all contracts above five million dollars (\$5,000,000.00).

IV. LIQUIDATED DAMAGES for delay will be prescribed. (See Paragraph 1-07 b. of the specifications.)

V. COMPENSATION FOR WORK shall be as provided in the Schedule of Bid Items. (See Paragraph 1-10 of the specifications.)

VI. PARTIAL PAYMENTS will be made. (See Article 16 of the contract and Paragraph 1-10 of the specifications.)

VII. TAX ADJUSTMENTS. - Provisions for tax adjustments will be made a part of the contract. (See Paragraph 1-11 of the specifications.)

VIII. ARTICLES ON PATENTS will be made a part of the contract. (See Paragraph 1-15 of the specifications.)

IX. BID AND CONTRACT. - a. Bids must be submitted upon the Standard Government Form of Bid and the successful bidder will be required to execute the Standard Government Form of Contract for construction. The bid form has an entry for each item on which estimates will be given or payments made, and no other allowances of any kind will be made unless specifically provided for in the specifications or the contract, or adjustments under Article 3 of the contract. A bid for the entire work must have each blank filled.

b. The quantities for each item of the bid, as finally ascertained at the close of the contract, in the units given and the unit prices of the several items stated by the bidder in the accepted bid, will determine the total payments to accrue under the contract. The unit price bid for each item must allow for all collateral or indirect cost connected with it.

c. The successful bidder will be required to return the contract duly executed and to furnish the performance and payment bonds hereinbefore described, within ten (10) days after the papers are presented to him.

X. EXPERIENCE. - a. Each bidder shall state in his bid whether he is now or ever has been engaged on any contract or other work similar to that proposed, giving the year in which it was done and the manner of its execution, and shall submit such other information as will tend to show his ability to prosecute vigorously the work required by these specifications.

b. The successful bidder will be required to employ competent organizations thoroughly experienced and skilled in the manufacture, fabrication and installation of the gates, gate hoists, gasoline-electric service unit, power and lighting system, and other equipment of like nature. After the opening of bids, any bidder may be required by the contracting officer to submit satisfactory evidence that the specific organizations which he proposes to employ on this portion of the contract have successfully executed work of the nature and quality indicated above.

XI. COMMENCEMENT AND COMPLETION. - Work shall be commenced within ten (10) calendar days after receipt of notice to proceed and shall be completed within 760 calendar days, in accordance with the provisions of Paragraph 1-07 a. of the specifications.

XII. MINIMUM WAGE RATES for the locality of the work have been determined by the U. S. Department of Labor, and proof of payment of such wages will be required. (See Articles 17 and 19 of the contract and Paragraph 1-37 of the specifications.)

XIII. ARTICLES ON RELIEF LABOR will be made a part of the contract (see Paragraph 1-37 of the specifications).

XIV. EIGHT-HOUR LAW. - The requirements of the Eight-hour Law, Article 11 of the contract, will be applicable to all installation and similar work involving the employment of laborers and mechanics by the contractor at the site of the work.

XV. ARTICLES ON PREFERENCE for domestic materials will be made a part of the contract. (See Article 18 of the contract and Paragraph 1-33 of the specifications.)

XVI. REPORTS TO THE DEPARTMENT OF LABOR. - In order to assist the Department of Labor in obtaining employment statistics, bidders, unless otherwise indicated in their bids, will be considered as having voluntarily consented, without cost to the Government, to the inclusion of Paragraph 1-38 of the specifications as a part of the contract.

XVII. INVESTIGATION OF CONDITIONS. - Samples of borings and samples from test pits taken at the dam site can be seen at the U. S. Engineer Laboratory at Providence, R. I., where they should be inspected by prospective bidders. Bidders are expected to visit the locality of the work and acquaint themselves with all available information concerning the nature of the materials to be excavated for the dam or structure excavations, the nature of the materials to be transported and placed in the dam embankments and the local conditions bearing on transportation, hauling and storage of materials. They are also expected to make their own estimates of the facilities needed, the difficulties attending the execution of the proposed contract, including local conditions, availability of labor, uncertainties of weather, and other contingencies. In no case will the Government assume any responsibility whatever for any interpretation, deduction, or conclusion drawn from the examination of the site. At bidder's request a representative of the Government will point out the site of the proposed operations. Failure to acquaint himself with all available information concerning these conditions will not relieve the successful bidder of as-

suming all responsibility for estimating the difficulties and costs of successfully performing the complete work.

XVIII. FACILITIES AVAILABLE FOR CONSTRUCTION are described in Paragraph 1-06 of the specifications.

XIX. DATA TO BE SUBMITTED WITH BIDS. - a. Each bidder will be required to furnish with his bid a description of the equipment to be furnished under Items 39 and 40, respectively, designated Gatos and Accessories, and Gasoline-Electric Standby Unit; such description shall include the names of manufacturers, fabricators, and erectors of the equipment, together with such drawings, bulletins, catalogs, references, and other pertinent data as may be required. (See Sections XIV and XV of the specifications).

b. Each bidder shall submit with his bid also, drawings showing proposed plant layout and charts showing the rate of progress the bidder will maintain on the work, carefully prepared and presented in neat and legible form. These data are considered essential in assisting the contracting officer to determine whether or not the bidder is responsible, experienced in similar types of construction, and that his bid is based on a careful study of construction methods applicable to the work, and with a full realization of the various factors which may affect its progress.

c. The drawings indicating the plant layout shall clearly show the location and manner of employment of the various major items of plant, the sizes and types of cofferdams, the method of excavation and disposal of materials, and the manner in which structural features will be erected.

d. The progress charts shall indicate the volume of work to be done and the rate of progress which the bidder agrees to maintain for each of the following major operations required in the performance of the work under these specifications: Cofferdams, Excavations, Tunnel Driving, Concreting, Earth Embankment, and Rock Fill. These charts may be in any convenient form in which the time element shall be plotted to represent definite intervals of time measured from date of notice to proceed with the work, and the volume of work shall be represented by a suitable scale of percentage of completion based on the estimated contract quantities. Careful consideration shall be given to the preparation of the charts as the contractor will be required to maintain the rate of progress thus proposed.

XX. PLANT. - Each bidder shall state in his bid the character and amount of plant that he proposes to employ on the work. After bids are opened any bidder may be required to show that he owns, controls or can procure the plant necessary for commencing, prosecuting, and completing the work as required by the specifications.

XXI. AWARD OF CONTRACT. - a. Subject to the rights hereinafter reserved, the work will be awarded as a whole to one bidder. The right

is reserved, as the interest of the Government may require, to reject any and all bids, to waive any informality in bids received, and to accept or reject any items of any bid, unless such bid is qualified by specific limitation.

b. A bid may be rejected if the bidder cannot show that he has the necessary capital and experience, and owns, controls or can procure the necessary plant to commence the work at the time prescribed in the specifications and thereafter to prosecute and complete the work at the rate or time specified; and that he is not already obligated for the performance of other work which would delay the commencement, prosecution or completion of the work contemplated in this advertisement.

c. Any unbalanced bid which, in the opinion of the contracting officer, jeopardizes the interest of the United States will be subject to rejection for that reason.

XXII. ADDRESS FOR BIDS. - Bids submitted must be in envelopes with sufficient postage, sealed, marked, and addressed as follows:

(Marked in upper left-hand corner)

Bid for construction of Surry Mountain Dam on the Ashuelot River, New Hampshire. To be Opened July 21, 1939.

(Addressed to)

District Engineer,  
United States Engineer Office,  
819 Industrial Trust Building,  
Providence, Rhode Island.

Note. -- See Standard Government Instructions to bidders and copy of the Standard Government Forms of contract, bid bond, payment bond, and performance bond, which may be obtained upon application.

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Invitation No. 699-39-362,  
U. S. Engineer Office,  
Providence, R. I.,  
June 20, 1939.

WAR DEPARTMENT

CONNECTICUT RIVER VALLEY FLOOD CONTROL RESERVOIRS, PROJECT NO. 57A.

APPROPRIATION: 21-3113 FLOOD CONTROL, GENERAL.

SPECIFICATIONS FOR CONSTRUCTING SURRY MOUNTAIN DAM.

SECTION I. GENERAL PROVISIONS.

1-01. Location. - The site of the work contemplated by these specifications is on the Ashuelot River about 34.6 miles above its confluence with the Connecticut River and about 5 miles northwest of Keene, in the Town of Surry in Cheshire County, New Hampshire. Keene is located at the junctions of State Highways N. H. 9, N. H. 10, N. H. 12 and N. H. 101; and at the junction of two branches of the Boston and Maine Railroad, the Worcester, Mass.-Bellows Falls, Vt., and the Springfield, Mass.-Keene, N. H. branch. Keene is about 60 miles from Worcester and 73 miles from Springfield, Mass.

1-02. Work to be done. - a. The work provided for herein is authorized by the Flood Control Act approved June 22, 1936, (Public No. 738, 74th Congress) and as amended May 15, 1937.

b. The work to be done consists of furnishing all plant, labor, and materials, and performing all work required for constructing a rolled earth fill dam, inlet structure, outlet works, spillway, and all appurtenant works, complete in accordance with these specifications, and the maps and drawings forming a part hereof. It will consist of the following major items:

(1) Construction of outlet works consisting of a concrete lined tunnel and outlet channel, intake structure and approach channel, and operating house; and furnishing and installing all gates and equipment.

(2) Diversion and care of river during construction.

(3) Construction of an earth dam by the rolled fill method with an impervious core of fine material and with permeable stable shoulders of coarse material, and with rock-filled toe trenches.

(4) Construction of concrete spillway and retaining walls including excavation of spillway channels.

(5) Construction of access road, road across dam and bridge to operating house.

(6) Such other incidental work at the site as may be required for completion of the work within the intent and scope of these specifications, or as may be ordered in writing by the contracting officer.

1-03. Description of project. - a. The dam will be of the rolled fill type about 1,570 feet long at the top elevation of 565 M.S.L. with a maximum height above stream bed of about 83 feet. The central portion of the embankment will be of selected impervious material enclosed within random impervious material and the outer sections will be of pervious material, grading from finer sizes near the impervious section to coarser sizes near the outside slopes. The slopes will be covered with rock fill and riprap. Rock toes will be placed at the foot of each slope.

b. The outlet works will be located in the west abutment and will consist of an outlet tunnel, a gate shaft and an operating house. An approach channel will be excavated across the valley leading to the intake on the hillside. The tunnel will discharge directly into the spillway channel below the center line of the dam. Two service gates and one emergency gate with operating machinery will be installed in the gate structure. A short bituminous-surfaced road on the west bank with an access bridge across the spillway channel will be constructed to provide access to the operating house and the top of the dam.

c. The spillway weir with its approach and discharge channel will be constructed on the west bank adjacent to the right abutment of the dam.

1-04. Drawings. - a. The work shall conform to drawings marked Connecticut River Flood Control, Surry Mountain Dam, as listed below, which drawings form a part of these specifications and are filed in the United States Engineer Office, Providence, Rhode Island.

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51	Access Road	CT - 1 - 1207
52	Access Bridge - Substructure	CT - 1 - 1229
53	Access Bridge - Superstructure No. 1	CT - 1 - 1230
54	Access Bridge - Superstructure No. 2	CT - 1 - 1231
55	Field Office	CT - 1 - 1210

b. The work shall also conform to such other drawings relating thereto as may be exhibited in the office of the contracting officer prior to the opening of proposals and to such drawings used in explanation of details as may be required from time to time during construction, including such minor modifications as the contracting officer may consider necessary on account of conditions discovered during the prosecution of the work.

c. Prior to performing the work, the contractor shall check all drawings and shall immediately report to the contracting officer any errors or omissions discovered therein. Quantities stated in bills of material on contract drawings are approximate and the contractor shall furnish the required quantity without change in unit price. All items to be furnished at lump sum prices shall be provided by the contractor, complete and in good working order, regardless of whether or not they are fully shown or listed on the contract drawings. The parts and details not fully shown on the drawings shall be drawn in detail by the contractor in accordance with best practice and four copies of each drawing shall be submitted to the contracting officer for approval. No material shall be furnished for or work done on such parts pending approval of these drawings. Each set of drawings submitted for approval shall have in the lower right-hand corner just above the title a white space approximately 5" x 4", to be used for notations by the contracting officer. After approval by the contracting officer, and before the corresponding work is commenced, one copy of each approved drawing will be furnished the contractor. All of these drawings shall form a part of this contract.

d. Ten sets of prints of all necessary drawings will be furnished the contractor without charge. Additional prints will be furnished upon request at the cost of printing.

1-05. Quantities. - The following estimate of quantities is given to serve as a basis for the comparison of bids and to determine the approximate consideration of the contract. Within the limits of available funds, the contractor will be required to perform the entire quantity of work necessary to complete the work specified in Paragraph 1-02 hereof, be it more or less than the amounts established herein.

(Schedule of Bid Items on following page)

# SURRY MOUNTAIN

## SCHEDULE OF BID ITEMS

ITEM	DESIGNATION	UNIT	QUANTITY
1	DIVERSION AND CARE OF RIVER	JOB	-
2	CLEARING AND GRUBBING	JOB	-
3	COMMON STRIPPING	CU.YDS.	46,000
4	COMMON EXCAVATION - GENERAL	CU.YDS.	148,000
5	COMMON EXCAVATION - BORROW PITS "A", "B", "C" & "E" (INCLUDING HAUL)	CU.YDS.	533,000
6	COMMON EXCAVATION - BORROW PIT "D" (INCLUDING HAUL)	CU.YDS.	225,000
7	CUT-OFF TRENCH EXCAVATION	CU.YDS.	31,000
8	ROCK EXCAVATION - OPEN CUT	CU.YDS.	107,000
9	LINE DRILLING AND BROACHING	SQ.FT.	500
10	TUNNEL EXCAVATION (ROCK)	CU.YDS.	2,800
11	GATE SHAFT EXCAVATION (ROCK) (EL. 498 to EL. 548)	CU.YDS.	700
12	TIMBERING	M.F.B.M.	5
13	(deleted, but item number retained)		
14	ROLLED EMBANKMENT	CU.YDS.	867,000
15	SELECTED PERVIOUS FILL	CU.YDS.	37,000
16	FILL (UNCLASSIFIED) - ACCESS ROAD	CU.YDS.	1,800
17	COMPACTED BACKFILL	CU.YDS.	53,500
18	SEMI-COMPACTED BACKFILL	CU.YDS.	6,400
19	GRAVEL FOR ROADS	CU.YDS.	2,000
20	DUMPED ROCK IN EMBANKMENT	CU.YDS.	136,500
21	MISCELLANEOUS ROCK FILL	CU.YDS.	1,100
22	RIPRAP - HAND PLACED	CU.YDS.	1,600
23	RIPRAP - DERRICK STONES	CU.YDS.	4,000
24	GRAVEL AND CRUSHED STONE DRAINS*	LIN.FT.	530
25	TOE DRAIN (ROCK FILL)	CU.YDS.	5,900
26	CORE OR ROTARY DRILLING IN ROCK OR CONCRETE	LIN.FT.	500
27	ORDINARY DRILLING	LIN.FT.	2,300
28	PRESSURE GROUTING	CU.FT.	2,000
29	PORTLAND CEMENT	BBL.	12,800
30	CONCRETE IN TUNNEL LINING (TYPICAL SECTION)	CU.YDS.	840
31	CONCRETE IN TUNNEL LINING (TRANSITION SECTION)	CU.YDS.	670
32	CONCRETE IN GATE SHAFT (EL. 505 to EL. 544.5)	CU.YDS.	380
33	CONCRETE IN OPERATING HOUSE SUBSTRUCTURE (BASEMENT)	CU.YDS.	330
34	CONCRETE IN INTAKE AND OUTLET STRUCTURES	CU.YDS.	570
35	CONCRETE IN SPILLWAY WEIR, SPILLWAY LINING, RETAINING WALLS AND GROUTING CAP	CU.YDS.	6,000
36	CONCRETE IN ROAD AND BRIDGE STRUCTURES	CU.YDS.	135
37	FURNISHING, BENDING AND PLACING STEEL REINFORCEMENT	LB.	128,730
38	OPERATING HOUSE SUPERSTRUCTURE	JOB	-
39	STEEL FOR ACCESS BRIDGE	LB.	80,000
40	FURNISHING AND INSTALLING GATES AND ACCESSORIES	JOB	-
41	FURNISHING AND INSTALLING GASOLINE-ELECTRIC STANDBY UNIT	JOB	-

SCHEDULE OF BID ITEMS (Continued)

<u>ITEM</u>	<u>DESIGNATION</u>	<u>UNIT</u>	<u>QUANTITY</u>
42	FURNISHING AND ERECTING MISCELLANEOUS STRUCTURAL STEEL	LB.	22,000
43	FURNISHING AND INSTALLING MISCELLANEOUS IRON AND STEEL	LB.	6,200
44	FURNISHING AND INSTALLING MISCELLANEOUS WROUGHT IRON PIPE	LB.	2,500
45	FURNISHING AND INSTALLING MISCELLANEOUS BLACK STEEL PIPE	LB.	13,500
46	FURNISHING AND INSTALLING MISCELLANEOUS BRASS AND BRONZE	LB.	700
47	FURNISHING AND INSTALLING COPPER WATER STOPS	LB.	4,300
48	FURNISHING AND INSTALLING ELECTRIC LIGHT AND POWER SYSTEM	JOB	-
49	FURNISHING AND ERECTING HIGHWAY CABLE GUARD RAIL - COMPLETE	LIN.FT.	700
50	FURNISHING AND ERECTING CABLE GUARD FENCING - COMPLETE	LIN.FT.	1,300
51	FURNISHING AND PLACING BITUMINOUS MACADAM ROAD SURFACE	SQ.YDS.	1,400
52	FURNISHING AND INSTALLING GAGES - TILE AND STAFF	JOB	-
53	FIELD OFFICE	JOB	-
54	CLEANING UP	JOB	-

1-06. Physical data. - a. General. - Materials for constructing the embankment are available in the vicinity of the work. Locations of borrow areas are shown on the drawings. Borings and test pits have been made in the vicinity of the proposed work with reasonable care and substantially at the places indicated on the drawings. Laboratory analyses have been made of the samples from many bore holes and test pits. Samples of materials taken from them, and records of laboratory analyses and other studies may be seen at the United States Engineer Office, Providence, Rhode Island. Samples and records available are believed to represent fairly the conditions at the site of the work, but it is expressly understood that the Government will not be responsible for any deduction, interpretation, or conclusions made by the contractor from his inspection of the available samples and records. These samples of materials and contract drawings represent all the pertinent information on subsurface exploration which the Government has made at the site,

b. Stream flow. - (1) The Ashuelot River drains a total area of about 420 square miles, principally in New Hampshire; 100 square miles of which are above the dam site. The basin is long and narrow, and generally hilly, with low mountains near the headwaters. There are several lakes and ponds in the basin. Although the total fall of the river is great, most of it is concentrated at the stream, in general, has flat slopes except at wide intervals. The soil is generally sand and gravel with large ground water storage capacity. As a result of these general conditions, flood peaks are somewhat modified.

(2) There are four U.S.G.S. stream gaging stations on the Ashuelot. Two of these, at Hinsdale (D.A. = 420 square miles) and Gilsum (D.A. = 71.1) have been used to derive the hydrographs for the river at the dam site for the period from 1907 to date. This continuous hydrograph, and the basis of its preparation, are shown in the set of drawings accompanying these specifications. The maximum flood of record, that of March 1936, had an estimated peak discharge of 5,500 c.f.s. at the dam site, or 55 c.f.s. per square mile, corresponding to a flood of approximately 65-year average frequency. The estimated peak discharge of a 10-year average frequency is 3,300 second foot; of a 5-year frequency, 2,800 second foot.

c. Weather conditions. - The climate is characterized by frequent weather changes. The winters are cold and of longer duration than the summers. Winter temperatures may be expected as low as 20 degrees below zero. The average annual snowfall is about 65 inches; the average annual precipitation about 37 inches; and the average annual temperature is about 45 degrees Fahrenheit. The U. S. Weather Bureau station at Keene, N. H. is about 5 miles from the dam site. Meteorological data determined from the records of this Keene station for a period of over 30 years are given below.

Month	Aver. Mean Monthly Temp. (degrees F)	Aver. Monthly Prec. (Inches)
January	20.7	2.70
February	21.0	2.77
March	32.5	3.13
April	43.8	2.85
May	55.4	3.10
June	63.6	3.16
July	68.9	3.82
August	66.2	3.93
September	59.4	3.43
October	48.7	2.73
November	36.5	3.01
December	<u>24.8</u>	<u>2.86</u>
	45.1	3.13

Average yearly precipitation - 37.59

d. Electric power facilities. - Power can be supplied to the Surry Mountain dam site by the Public Service Company of New Hampshire with local office at Keene, N.H. and main office at Manchester, N.H. At present a 4,600-volt single phase line follows the road on the right bank adjacent to the dam site. Three-phase power at 2,300 volts is available in Keene, four miles from the dam site. A larger power supply for construction purposes is available, as a 13,200-volt transmission line between Keene and Gilsom passes within 2 miles of the dam site. This line could be tapped and a new line constructed along the road on the left bank of the Ashuelot River to the dam site. Prior to the commencement of work under the contract, the contracting officer will arrange for the relocation of the 4600-volt power line and adjacent telephone line that are within the limits of the work.

e. Transportation facilities. - (1) The nearest railroad station is located in Keene, New Hampshire, at the junction of the Worcester-Bellows Falls and Springfield-Keene branches of the Boston and Main Railroad. The station has adequate siding capacity and can accommodate a large number of cars. Loads longer than one car are unloaded on a siding at the main street. All sidings are easily reached by trucks. There is no unloading equipment. Adequate storage facilities are available. The contractor shall make his own investigation of and arrangements for siding capacity and other railroad facilities required for unloading of equipment and materials.

(2) The dam site may be reached from Keene by roads on either side of the Ashuelot River. The road on the right bank is bituminous surfaced and leaves Keene by way of N.H. Highway No. 12. This road will be closed to traffic on September 1, 1940, and the contractor shall maintain traffic over the road until that date. The road on the left bank is bituminous surfaced and crosses the river about 2.3 miles north

of Keene, joining the above-mentioned bituminous surfaced road about 2.5 miles from Keene. A continuation of the road on the left bank follows the left bank upstream to within 2,000 feet of the dam site, where it joins the road on the right bank; this is a gravel road in poor condition. The contractor shall provide his own construction roads and shall make his own investigation of all existing roads and the capacities of existing bridges.

1-07. Commencement, prosecution and completion. - a. The contractor will be required to commence the work under the contract within ten (10) calendar days after date of receipt by him of notice to proceed, to prosecute the said work with faithfulness and energy, and complete the entire work within 760 calendar days after said date of receipt of notice to proceed. The contractor shall complete the embankment on the left bank of the river to Elevation 525 as shown on the drawings by November 1, 1940 as specified in Section II and divert the river through the tunnel by May 1, 1941.

b. Liquidated damages. - In case of failure on the part of the contractor to complete the work within the time determined and agreed upon for its completion plus any extensions duly granted under the terms of the contract, the contractor shall pay the Government as liquidated damages the following: For delay in completing the embankment on the left bank of the river to Elevation 525 by November 1, 1940 the sum of fifty dollars (\$50.00) for each calendar day of delay; for delay in completing the work sufficiently to permit diversion of the river through the tunnel by May 1, 1941 the sum of two hundred dollars (\$200.00) for each calendar day of delay; for delay in completing the entire work under the contract, the sum of fifty dollars (\$50.00) for each calendar day beyond the date fixed or stipulated in a above until all work is completed and accepted.

1-08. Sundays, holidays, and nights. - No work shall be done on Sundays or on days declared by Congress as holidays for per diem employees of the United States except in cases of emergency, and then only with the written consent of the contracting officer. Work may be done at night when authorized in writing by the contracting officer (see Paragraph 1-20).

1-09. Progress, organization, and plant. - a. The contractor shall employ at all times an ample force of men with proper experience in their respective assignments; and provide equipment and a construction plant properly adapted to the work, and of sufficient capacity and efficiency to accomplish the work in a safe and workmanlike manner at the rate of progress specified in his bid. All plant and equipment shall be maintained in good working order, and provision shall be made for immediate emergency repairs. The contracting officer may order the removal and require replacement of any unsatisfactory plant or equipment. No reduction in the capacity of the plant employed on the work shall be made, except by written permission of the contracting officer. The measure of "Capacity of the plant" shall be its actual performance on the work to which these specifications apply. It is understood that award of this contract shall not be construed as a guaranty by the United States that

the plant and equipment listed by the contractor in the bid form is adequate for the performance of the work.

b. Should the contractor fail to maintain the rate of progress proposed in his bid, the contracting officer may require that additional men, equipment or plant be placed on the work, or a reorganization of plant layout be effected in order that the work be brought up to schedule and maintained there. Should the contractor refuse or neglect to comply with these requirements to the satisfaction of the contracting officer, the contracting officer will proceed under the provisions of Article 9 of the contract.

1-10. Payments. - a. The River and Harbor Act approved September 22, 1922, contains the following provisions:

That any work of improvement herein adopted and any Public work on canals, rivers, and harbors adopted by Congress may be prosecuted by direct appropriations, by continuing contracts, or by both direct appropriations and continuing contracts.

b. Under the contract to be entered into under these specifications, such work as may be done after June 30, 1940, or in excess of the amount for which funds are available for payment as herein set forth, will be continued with funds to be hereafter appropriated.

c. From funds heretofore appropriated by the Act of June 11, 1938, for the maintenance and improvement of existing improvements of river and harbor works, the sum of \$1,070,000 has been initially allotted and will be reserved for payment in connection with this contract, including all costs of superintendence and inspection and all collateral and incidental expenses in connection therewith. Of this sum, the amount of about \$800,000 is available for payments of the contractors' estimates.

d. If at any time it becomes apparent to the contracting officer that the remaining balance of this allotment and reservation is in excess of the amount required to meet all payments due and to become due to the contractor, because of work performed and to be performed until June 30, 1940 and for all supervisory, collateral, and incidental expenses in connection therewith until that date, the right is reserved after due notice to the contractor to reduce said allotment and reservation by the amount of such excess.

e. If the rate of progress of the work is such that it becomes apparent to the contracting officer that the remaining balance of the allotment and reservation is less than that required to meet all payments due and to become due to the contractor because of work performed and to be performed until June 30, 1940 and for all supervisory, collateral, and incidental expenses in connection therewith until that date, the Government may allot and reserve additional funds for payments under this contract if there be funds available for such purpose. The contractor will be advised of any additional allotment so made.

f. It is expected that prior to June 30, 1940 Congress will make additional appropriations applicable to work under this contract, but it must be distinctly understood and agreed that the Government is in no case to be made liable for damages in connection with this contract on account of delay in payments on same due to a lack of available funds. Should it become apparent that the available funds will be exhausted before additional funds are appropriated, the contracting officer will give 30 days' written notice to the contractor that work may be suspended, but, if the contractor so elects, he may continue work under the conditions and restrictions of the specifications, after the time set by such notice, so long as there are funds for inspection and superintendence, with the understanding, however, that no payment will be made for such work until additional funds shall have been provided in sufficient amount. When funds again become available, the contractor will be notified accordingly. Should work be thus suspended, additional time for completion will be allowed equal to the period during which work is necessarily so suspended, as determined by the dates specified in the above notices (See also Paragraph 1-07 a).

g. So long as funds are available, payments will be made monthly, in accordance with Article 16 of the contract for work executed and completed as specified or otherwise required, and not included in any prior estimate, subject to the conditions stipulated in these specifications for estimating for partial payments, except that 10 per cent of the amount of each estimate will be retained until the contract work is 50 per cent completed, and thereafter with each monthly payment there will be paid such portion of the amount so retained as in excess of 10 per cent of the estimated cost of completing the work remaining to be done, until the amount retained is reduced to \$25,000, after which the amount to be retained will remain unchanged until the completion of the contract.

h. The procedure above described will be repeated as often as may be necessary on account of the exhaustion of available funds and the necessity of awaiting the appropriation of additional funds by Congress.

i. Should Congress fail to provide additional funds during its regular session as expected, the contract may be terminated and considered to be completed, at the option of the contractor, without prejudice to him, at any time not later than 30 days after payments are discontinued, or if payments have been previously discontinued, not later than 30 days after the passage of the act which would ordinarily carry an appropriation for continuing the work, or after the adjournment of Congress without passing such act.

j. In event of termination of the contract prior to its completion, under the terms of Paragraph 1-10 i hereof, all balances due the contractor under the terms of the contract for work authorized and acceptably executed prior to date of said termination of contract will be paid, including retained percentage and less any proper deductions. The Government will take over, at cost to the contractor, all materials to be incorporated in the structures for which partial payment upon delivery is authorized by the specifications and procurement of which was authorized in writing by the contracting officer, deductions being made for any damaged or unsatisfactory material and for any costs of protection incurred by the Government.

1-11. Work covered by contract price. - a. The contractor shall, under the contract prices, furnish and pay for all material and labor, and all permanent, temporary, and incidental work, furnish all accessories, and do everything that may be necessary to carry out the work specified in good faith, which contemplates everything specified completed, in good working order, of good materials with accurate workmanship, skillfully fitted and properly connected and put together.

b. The contract price will be considered to include all Federal, State and local taxes imposed prior to the date of opening bids and applicable to the undertaking. If any privilege, sales, gross receipt or other tax (exclusive of taxes on net income or undistributed profits) applicable to the undertaking and payable directly by the contractor, is imposed or changed after the date of opening bids by Federal or State enactment, then the contract price will be increased or decreased accordingly and any amount due or chargeable against the contractor as a result thereof will be adjusted on payment vouchers as separate items.

1-12. Material to be furnished by the contractor. - a. The contractor will be required to furnish all materials and equipment, except the bronze plaque furnished by the Government as specified in Paragraph 12-01 b, necessary to fully complete the work to be done under these specifications. The cost of unloading and loading, handling, hauling, storing, and caring for all materials furnished by the contractor shall be included in the contract prices for the work to which the materials pertain. All materials, supplies and articles delivered at the site shall be adequately housed or otherwise protected against deterioration and damage. When material stored at the site and partly paid for is not adequately protected by the contractor, such material will be kept protected by the contracting officer, at the expense of the contractor, and no further partial payments will be made thereon.

b. The contractor guarantees all equipment supplied by him under this contract, against defects of materials and workmanship for a period of one year, and any articles or parts proving defective within that time shall be replaced by him without cost to the Government.

1-13. Order of work. - The work shall be carried on at such places and also in such order of precedence as may be found necessary by the contracting officer. The contractor shall submit for approval of the contracting officer, his proposed program in writing giving the sequence of construction operations contemplated. The location and limits of the work to be done will be plainly indicated by stakes, lines, marks, or otherwise as established by the contracting officer or his agents.

1-14. Damage. - Damage to Government property due to the failure of the contractor to take reasonable precaution, and all loss or deterioration of, or damage to any of the work by flood, accident or exposure prior to final acceptance of the work, shall be made good by the contractor without expense to the Government; except that the Government will compensate the contractor for repairs to the permanent work if damaged by floods overtopping the cofferdams as specified in Paragraph 2-05.

1-15. Patents. - The contractor shall hold and save the Government, its officers, agents, and employees harmless from liability of any nature or kind, including costs and expenses, for or on account of any patented or unpatented process, or invention, article, or appliance manufactured or used in the performance of this contract, including its use by the Government.

1-16. Grounds and right of way. - a. Grounds and right of way, needed for the work to be done under these specifications, will be furnished by the Government. The Government will not be held liable for any delay in furnishing the grounds or right of way, but in case such delay retards the operations of the contractor, the contracting officer will grant an extension of time for the completion of the work equal to the time of delay. The contractor shall have the privilege of using the Government controlled land at the site, not otherwise reserved by the contracting officer; provided that plans for all construction, storage, or other operations proposed thereon by the contractor are submitted for approval to the contracting officer, prior to the occupation of such areas.

b. It is understood, however, that the contractor shall, without expense to the Government, at any time during the progress of the work and when space is needed for other purposes, promptly vacate and clean up any part of the grounds allotted to or in use by him, when directed to do so by the contracting officer.

1-17. Clearing, preservation of trees, temporary fences. - Trees and other obstructions shall be removed from the sites of the proposed structures and of the borrow areas when and as directed, and may be removed from other areas only to the extent directed or permitted. The contractor shall preserve and protect from injury all trees not required to be removed. The contractor shall assume all responsibility for the protection of animals and other property of adjacent owners so far as affected by his operations and shall build and maintain such temporary fences as may be required to permit the reasonable use of such adjacent property and no separate payment will be made for such fences.

1-18. Stream turbidity. - The contractor shall conduct his operations so that the turbidity of the water in the Ashuelot River will not be increased to a degree which, in the opinion of the contracting officer, is detrimental to its use in industrial processes.

1-19. Removal of rubbish. - The contractor shall keep the site free from rubbish. Suitable repositories for receiving refuse from the camp, kitchen, or grounds, shall be provided, and the rubbish shall be removed and disposed of as directed by the contracting officer. At the conclusion of the work, the site shall be cleaned up and all rubbish and unused materials shall be disposed of in accordance with Paragraph 18-05 of these specifications.

1-20. Obstruction and danger lights. - In the contractor's use of the highways, for the work to be done under these specifications, he shall

conduct his operations so as to cause no greater obstruction to the traveling public than is considered necessary by the contracting officer.

The contractor shall provide, erect and maintain effective barricades, danger signals, and signs on all intercepted roads or highways, and on the site where directed by the contracting officer for the protection of the work and safety of the public. All barricades and obstructions which encroach on or are adjacent to public rights of way and all plant connected with the work when directed by the contracting officer shall be provided with lights at night and all such lights shall be kept burning between sunset and sunrise. Such barricades and lights shall conform to the local and state laws. The contractor shall be responsible for all damages resulting from any neglect or failure of these requirements. The expense of these and other safety precautions shall be borne by the contractor.

1-21. Inspection and supervision. - a. General. - The work will be conducted under the general direction of the contracting officer, and will be inspected in accordance with Article 6 of the contract, by inspectors appointed by him. The inspectors so appointed will be authorized to reject material or work which in their opinion does not conform to the requirements of the specifications. Any rejected material shall be removed from the site without delay, and any defective work shall be replaced, unless in the particular case the inspector's action is overruled by the contracting officer. The contracting officer will furnish on request to the contractor, all location and limit marks reasonably necessary as provided in Paragraph 1-23 hereof. The inspectors will keep a record of work done, and see that the location and limit marks are kept in proper order; work done without proper inspection may not be paid for. The presence of an inspector shall not relieve the contractor of his responsibility for the superintendence required in the proper execution of the work (see Article 8 of the contract). Tests to determine the quality and fitness of material used and work done under these specifications will be made as indicated under that part of the specifications pertinent to the particular kind of work, and subject to the provisions of Paragraphs 1-32 and 1-39. It is understood that any instructions or decisions given by a superior officer, through the contracting officer, are to be considered instructions or decisions of the contracting officer, in all cases under the terms of the contract where decision rests with the contracting officer.

b. Facilities to be furnished. - (1) The contractor shall furnish promptly, in accordance with Article 6 of the contract, all reasonable facilities, labor, and materials necessary for the safe and convenient inspection and tests that may be required by the contracting officer and his inspectors.

(2) The contractor shall furnish an appropriate room approximately 20 feet long by 12 feet wide, at his concrete mixing plant for a Government laboratory, to be used for making field tests including the moisture content of aggregates and such other field tests as are prescribed in these specifications under SECTION X and for temporary

storage of concrete specimens. The room shall be protected from the weather, properly lighted, and heated, all of which together with the location and capacity will be subject to the approval of the contracting officer. The contractor shall provide electricity in accordance with Paragraph 1-36 hereof.

(3) No separate payment will be made to the contractor for providing these facilities, except for the electric power used. Should the contractor refuse, neglect, or delay compliance with the requirements concerning facilities for inspection, the specific facilities may be furnished and maintained by the Government, and the cost therefor will be deducted from any amounts due or to become due the contractor.

1-22. Datum and bench marks. - The plane of reference used in these specifications and on the drawings thereof is mean sea level datum. Elevations in feet as specified and as shown on the drawings are to be determined from bench marks located at the site of the work, the locations, descriptions, and elevations (in feet) of which are as follows:

#### DESCRIPTION OF BENCH MARKS

AT

#### SURRY MOUNTAIN DAM SITE

U.S.G.S.

B.M. Disc. C-29-1926

El. 538.00 m.s.l.

Surry Town Tablet on west side of road on catch basin 150 feet north of cemetery in the Town of Surry approximately one and one-half miles north of dam site.

B.M. No. 1

El. 557.95

Chiseled square on large boulder, 10 feet from west edge of Tarvia highway, 75 feet south of junction with farm road. B.M. for dam site.

T.B.M. D2 El. 540.492

Chiseled square on boulder in stone wall at barway 350 feet south of dam site, on east side of road.

T.B.M. D3 El. 489.593

Chiseled square on corner of boulder east of cart path; 250 feet ± south of dam site on right bank at west edge of field.

T.B.M. D4 El. 490.868

Chiseled square on boulder 500 feet ± north of center line of dam site on west edge of meadow on right bank.

T.B.M. D5 El. 493.070

Spike in root of 3-foot rock maple on line fence 500 feet ± south of base line on left bank.

1-23. Lines and grades. - a. The contractor shall keep the contracting officer informed a reasonable time in advance of the times and places at which he intends to do work in order that lines and grades may be given, necessary measurements for record and payment made and progress photographs taken with a minimum of inconvenience to the contracting officer or of delay to the contractor, and the contractor shall have no claim for damages or extension of time on account of delays in the giving of lines and grades or due to destruction of such marks and the consequent necessity for replacement. Whenever the contracting officer finds it necessary to carry on his operations on Sundays, legal holidays or at other times when the work of the contractor is not in progress, the contractor shall furnish all necessary service and assistance. No direct compensation shall be made for the cost to the contractor for any of the work or delay occasioned by giving lines and grades or making other necessary measurements or by inspection, but compensation shall be considered as having been included in the prices stipulated for Items 1 to 54 inclusive.

b. All lines and grades will be given by the Government inspectors as authorized representatives of the contracting officer, but the contractor shall provide at his own expense such temporary structures and such materials and give such assistance as may be required by the contracting officer and the marks given shall be carefully preserved. After lines, elevations, and grades for any part of the work have been given by the contracting officer, the contractor will be held responsible for the proper execution of the work to such lines, elevations, and grades, and all stakes or other marks given shall be preserved by the contractor until they are authorized to be removed by the contracting officer. The contracting officer may require the work to be suspended when for any reason such marks cannot be properly followed.

1-24. Repair shops and duplicate parts. - The contractor shall establish and arrange for one or more suitable repair shops conveniently located with respect to the work, also he shall have at the site of the work at all times, duplicates in good condition of such machines, or parts of machines, or appliances as are especially likely to wear rapidly, break, or be lost.

1-25. Water supply. - The contractor shall provide at convenient points ample supplies of water of proper quality for all the operations required under this contract, including the water required for the rolled fill construction. The contractor will be allowed to pump water from the Ashuelot River for use in the construction operations. Proper piping systems shall be installed, maintained and extended from time to time to distribute water to the various portions of the work where it is needed, including a satisfactory supply to the Government field office and contractor's camp. Wherever necessary, the water shall be under sufficient pressure for construction purposes.

1-26. Use of explosives. - The contractor shall use the utmost care in the use of explosives necessary for the prosecution of the work, not to endanger life or property. All blasting operations shall be conducted by experienced men only. The handling and use of explosives shall be done strictly in accordance with the latest methods and rulings to insure safety, in accordance with the specifications issued by the U. S. Bureau of Mines, and in compliance with the local and state laws. Failure to observe necessary precautions will be sufficient grounds for temporary suspension of the work. All explosives shall be stored in a secure manner, and in accordance with local and state laws; all such storage places shall be marked clearly "DANGEROUS - EXPLOSIVES," and shall be in care of competent watchmen at all times. In no case shall caps or other detonators be stored with dynamite or other explosives. The locations of magazines for the storage of explosives and for the separate storage of detonators shall be subject to the approval of the contracting officer.

1-27. Contractor's camps, intoxicating liquors. - a. Subject to the approval of the contracting officer, the buildings which may be acquired with the land provided by the Government for the purposes of this contract, may be turned over to and become the property of the contractor. The contractor shall alter, repair, and maintain, to the extent necessary, such of these buildings and appurtenances as he desires to use. In addition thereto, the contractor may construct, upon the property controlled by the Government at approved locations, other buildings for housing his employees, storing his materials and for other purposes pertinent to the satisfactory completion of the work. Plans showing the camp layout and sanitary provisions shall be approved before erection is commenced. The contractor shall maintain good order and discipline in his camps and to that end shall employ such watchmen or other persons as may be required. Upon completion of the work, but not sooner unless so ordered or permitted, such of these buildings and other camp structures, that the contracting officer may permit, shall be removed. Buildings, not ordered or permitted to be removed upon completion of the work, shall become the property of the Government.

b. The contractor shall not sell intoxicating liquors on or about the works, and shall not permit their sale, introduction or use upon the works, embraced by this contract, nor upon any of the grounds occupied or controlled by him.

1-28. Standard Stock Products. - All material, supplies and articles furnished shall, wherever so specified and otherwise wherever practicable, be the standard stock products of recognized reputable manufacturers. The standard stock products of manufacturers other than those specified will be accepted if, in the opinion of the contracting officer, they are equal in strength, durability, usefulness, and convenience for the purpose intended. (See Article 7 of the contract.) Any changes required in the details and dimensions shown on the drawings for the substitution of standard stock products, other than those provided for, shall be properly made as approved by the contracting officer, and at the expense of the contractor.

1-29. Safety requirements. - a. The contractor shall make all necessary provisions to protect the public safety, and to maintain and protect existing structures of whatever kind, and shall repair all damages done to such structures. He shall give ample notification to the proper officials of any city or town and of any public utility or other corporation before entering upon their respective public ways or rights of way to perform the required work of construction. Such construction shall conform to the customary regulations and requirements of said officials or corporations. The contractor shall give all notices, take out all permits, and pay all such charges, fees, water and other rates that may be necessary in the carrying out of the work.

b. The contractor shall be responsible that his employees strictly observe the laws of the United States affecting all operations at the site under the contract. He shall comply with all applicable Federal and state laws under which he is operating, including those concerning the inspection of boilers and other equipment, the licensing of engineers, welders and other employees.

c. The contractor shall conduct the work with due regard to adequate safety and sanitary requirements and shall maintain his plant and equipment in safe condition. He shall conform to current safety engineering practices as set forth in the Manual of Accident Prevention in Construction, published by the Associated General Contractors of America; the publications of the National Safety Council, and with all applicable state or local safety and sanitary laws, regulations and ordinances.

d. The contracting officer will require such safety and sanitary measures to be taken as the nature of the work and the conditions under which it is to be performed, demand. Such measures shall include;

(1) The provision of adequate extinguishers or fire-fighting apparatus in and about all buildings and plant erected or used at the site of the work;

(2) Adequate life-saving equipment;

(3) Adequate illumination during night operations;

(4) Instruction in accident prevention to reach all employees;

(5) Such machinery guards, safe walkways, scaffolds, ladders, bridges, gang planks, and other safety devices, equipment and apparel as are necessary to prevent accidents or injuries.

e. The contractor shall promptly report to the contracting officer in form prescribed by him all accidents occurring at the site of the work.

f. The contracting officer will notify the contractor in writing of any non-compliance with the foregoing provisions and the corrective action to be taken. If the contractor fails or refuses to comply promptly, the contracting officer may issue a stop order suspending all or any part of the work. Such stop order will be sent by registered mail to the contractor at the site of the work and shall be accepted by him as sufficient notice thereof. Work shall thereupon be suspended as directed. When satisfactory corrective action is taken, a resumption order will be issued. No part of the time lost due to any such stop order shall be made the subject of a claim for extension of time or for excess costs or damages by the contractor.

1-30. Interference with other contractors. - The contractor shall be subject to Article 13 of the contract regarding interference with materials, appliances, or workmen of the Government or of any other contractor who may have work at the site. As far as practicable, all contractors shall have equal rights to the use of all roads and grounds. In case of disagreement regarding such use, the decision of the contracting officer shall govern, subject to appeal under Article 15 of the contract.

1-31. Access to work. - The contracting officer, his authorized representative and other duly authorized agents and employees of the Government may at all times enter upon the work and premises used by the contractor or into his works or shops. The contractor shall provide safe and proper facilities for such entrance and for the inspection of materials and workmanship.

1-32. Defective work. - In accordance with the provisions of Article 6 of the contract, the inspection of the work will not relieve the contractor of any of his obligations to fulfill his contract as herein prescribed, defective work shall be made good, and unsuitable materials will be rejected, notwithstanding that such work and materials have been previously overlooked by the contracting officer and accepted or estimated for payment or paid for. If the work or any part thereof shall be found defective at any time before the final acceptance of the whole work or the final payment therefor, the contractor shall make good at once such defect in a manner satisfactory to the contracting officer, and if any material brought upon the ground for use in the work or selected for the same shall be condemned by the contracting officer as unsuitable or not in conformity with the specifications, the contractor shall remove at once such materials from the vicinity of the work.

1-33. Purchase of supplies and materials. - a. The provisions of Article 18 of the contract shall govern the purchase of supplies and materials to be used on the work covered by these specifications.

b. Preference for domestic articles. - (1) Because the materials listed below or the materials from which they are manufactured are not mined, produced, or manufactured, as the case may be, in the United

States in sufficient and reasonably available commercial quantities and of a satisfactory quality, their use in the work herein specified (subject to the requirements of the specifications) is authorized without regard to the country of origin.

Platinum	Rubber	Balsa wood
Chromium	Teakwood	English ball clay
Cork	Sisal	English china clay
Jute	Silk	Natural copper-nickel
Kauri gum	Tin	alloy (monel metal)
Lac	Asbestos	
Nickel	China wood oil	
	(tung oil)	

(2) Articles, materials, or supplies manufactured in the United States and containing mercury, antimony, tungsten, or mica of foreign origin may be used (subject to the requirements of the specifications) in the work herein specified, because such manufactured articles, materials, or supplies have been manufactured in the United States substantially all from articles, materials, or supplies mined, produced, or manufactured, as the case may be, in the United States.

c. Purchasing procedure. - Two copies of all purchase orders showing firm names and addresses, and of all shipping bills or memoranda of shipments received showing car initials and numbers, when shipped by railroad, shall be furnished promptly to the contracting officer. Such orders, shipping bills, or memoranda shall clearly indicate weights, and shall be so worded or marked that each item, piece or member can be definitely identified on the drawings.

1-34. Minor modifications. - The right is reserved to make such minor changes in the execution of the work to be done under these specifications as, in the judgment of the contracting officer, may be necessary or expedient to carry out the intent of the contract; provided that the unit cost to the contractor of doing the work shall not be increased thereby, and no increase in unit price over the contract rate will be paid to the contractor on account of such changes.

1-35. Protests and appeals. - The Chief of Engineers has been designated by the Secretary of War as his duly authorized representative to make final decision, and to take other action where the terms of the contract require that such decision or action shall rest with "the head of the department concerned or his duly authorized representative." If the contractor considers any work required of him to be outside the requirements of the contract, or if he considers unfair any action or ruling of the inspectors or contracting officer, he shall ask for written in-

struction or decision from the contracting officer immediately. Any protest based upon such instructions or decision, or claim otherwise arising under the contract, including a request for extension of time under Article 9 of the contract, shall be submitted to the contracting officer within the period specified in the contract. If the contractor is not satisfied with the ruling of the contracting officer he may, where appeal is stipulated in the contract, make written appeal to the Chief of Engineers. Such appeals, containing all the facts and circumstances upon which the contractor bases his claim for relief, shall be addressed to the Chief of Engineers, United States Army, and presented to the contracting officer for transmittal within the time provided therefor in the contract.

1-36. Electric power to be furnished by the contractor. - a. The contractor shall make arrangements for, shall pay for, and furnish all necessary power to carry on the work. No separate payment, other than as stipulated in sub-paragraph b hereunder, will be made to the contractor for the power furnished.

b. The contractor shall furnish sufficient power for lighting and other miscellaneous uses in Government buildings. The Government will pay the contractor monthly for power thus used upon the submittal of a properly executed invoice by the contractor. The rate to be paid by the Government shall be the actual cost to, or rate paid by the contractor, and this rate will be agreed upon by the contractor and the contracting officer prior to the commencement of the work. The contractor shall furnish and install a suitable meter for measuring the power used by the Government.

c. The Government will require different electric services from that now available at the site to operate the gates and machinery to be installed in the operating house. The Government will not require the contractor to provide this service.

1-37. Rate of wages. - a. In accordance with Article 17 of the contract, the minimum wages shown in the following schedule, as approved by the United States Department of Labor, shall be the minimum rates of wages to be paid by the contractor for work under this contract. Corresponding rates for occupations not listed below will be furnished upon application by the contractor.

<u>Designation</u>	<u>Wage Rate - Hourly</u>
Acetylene welder	\$ 1.00
Air tool operator (jack hammer)	.60
Blacksmith	1.00
Blaster (headman)	1.00
Powder monkey	.60
Boilormaker	1.00
Brickmason	1.25
Carpenter	.80

## (Rate of wages (continued))

<u>Designation</u>	<u>Wage Rate - Hourly</u>
Cement finisher	\$1.25
Cement gun nozzle man	.75
Concrete puddler (includes screeder and vibrator)	.60
Drill operator or runner	.75
Electrician	.85
Finisher (rough concrete)	.75
Fireman	.60
Form builder	.80
Fresno or scraper loader	.60
Handyman	.60
Hod carrier (mason tender)	.50
Ironworker (structural)	1.25
Labor (unskilled)	.45
Machinist	1.00
Mechanic	1.00
Mortar mixer	.60
Oilor	.60
Operator of Power Equipment:	
Cableway	1.25
Crane	1.25
Crusher	.90
Derrick	1.25
Dragline	1.25
Hoist (2 or more drums)	1.25
Hoist (1 drum)	1.00
Pile driver	1.25
Power shovel (steam or gas)	1.25
Roller (steam or gas)	.75
Steam locomotive	1.00
Stationary power plant	1.00
Tower excavator	1.25
Trenching machine	1.00
Operator of Small Equipment:	
Bulldozer	.75
Compressor (400 cu. ft. displacement or over)	.85
Compressor (under 400 cu. ft. displacement)	.60
Concrete mixer (5 bag or over)	1.00
Concrete mixer (under 5 bag)	.60
Grader (blade)	.75
Grouting machine	.65
Power saw	.80
Pump	.60
Tractor	.75
Driver of trucks:	
1-1/2 tons or less	.50
Over 1-1/2 tons	.60

(Rate of wages (continued))

<u>Designation</u>	<u>Wage Rate - Hourly</u>
Painter	\$ .80
Pile driving men	.75
Pipe layer	.60
Plumber	1.00
Reinforcing rod placer	1.12-1/2
Rigger	1.25
Sheet metal worker (roofer)	1.00
Steam fitter	1.00
Stone mason	1.25
Teamster	.50
Tunnel miner	.90
Tool dresser	1.00
Well drill operator	.85
Welders, acetylene and electric	1.00

b. Any class of laborers and mechanics not listed above, which will be employed on the work, will be classified or reclassified by the contracting officer to conform to the foregoing schedule. In the event of disagreement between the contracting officer and the contractor as to such classification or reclassification, the question, accompanied by the recommendation of the contracting officer, will be referred to the United States Department of Labor for final determination.

c. The above list of wages shall be posted by the contractor in a conspicuous place on the work.

d. The contractor shall employ as many laborers and mechanics as possible from relief rolls, provided such labor is qualified to do the work and can be secured from the locality of the site of the work or from the same source from which other labor is obtained. Such relief labor shall be subject to the same wage, hour, and other conditions generally applicable to labor under the terms of the contract.

1-38. Reports to Department of Labor. - The contractor shall report monthly, and shall cause all subcontractors to report in like manner, within 5 days after the close of each calendar month, on forms to be furnished by the Department of Labor, the number of persons on their respective pay rolls, the aggregate amount of such pay rolls, the man-hours worked, and the total expenditures for materials. He shall furnish to the Department of Labor the names and addresses of all subcontractors on the work at the earliest date practicable, provided that the foregoing shall be applicable only to work at the site of the construction project.

1-39. Standard Tests, Qualities, and Guarantees. - a. All materials, supplies and parts and assemblies thereof, entering into the work to be done under these specifications, shall be tested as specified, or other-

wise required, in conformity with the best modern approved methods for the particular type and class of work.

b. Unless waived in writing by the contracting officer, all tests and trials shall be made in the presence of a duly authorized representative of the contracting officer. When the presence of the inspector is so waived, sworn statements, in duplicate, of the tests made and the results thereof, shall be furnished to the contracting officer by the contractor.

c. Costs of all tests and trials, excepting the expense of the Government inspector and cement, concrete aggregate and cylinder tests, and tests on embankment materials, shall be borne by the contractor and shall be included in the contract price. (See paragraph 10-11).

d. All materials, parts and equipment shall be of the highest grade, free from defects and imperfections, of recent manufacture, new and unused. Workmanship shall be of the highest grade and in accordance with the best modern standard practice.

1-40. Welding and Welders. - a. Welders who have not been certified within two years of date of signing the contract will be required to pass successfully the tests as prescribed by the American Bureau of Welding or the Bureau of Navigation and Steamboat Inspection, before being assigned to production work. The contractor shall bear the expense of conducting these tests, and shall certify, by name, to the contracting officer, welders who have successfully passed the prescribed tests. The contractor shall require any welder to repeat these tests when, in the opinion of the contracting officer or his representative, the work of the welder indicates a reasonable doubt of his efficiency. In such cases the welder shall be recertified as above if he successfully passes the retest; otherwise he shall be disqualified until he has successfully passed a retest.

b. The assembly of all joints shall be such as to permit good welding. Welding shall not be used to close openings larger than those required for proper assembly.

1-41. Final acceptance and payment. - As soon as practicable after the completion of the entire work, it will be examined by the contracting officer, and all important machinery and operating parts will be operated through their range of operation, and if found to conform to the requirements of the contract and specifications will be accepted subject to the provisions of Paragraph 1-12b. The contracting officer will make a thorough examination of the entire project and if it is found to comply fully with the requirements of the contract, it will be accepted, and final payment will be made in accordance with Article 16 of the contract.

1-42. Approval. - This contract will be subject to the written approval of the Division Engineer, North Atlantic Division, Engineer Department, U. S. Army, and shall not be binding until so approved.

## SECTION II. (DIVERSION AND CARE OF RIVER (Item 1))

2-01. Work included. - a. The contractor shall protect the permanent construction and divert the Ashuelot River as provided for in Paragraph 1-18 and, unless otherwise authorized by the contracting officer, shall construct all permanent work under this contract in areas free from water. The contractor shall keep the diversion tunnel free from obstruction by ice or debris. Provisions shall be made to insure that no silt or other objectionable material enters the river, as the water is used for industrial purposes by plants downstream.

b. The contractor, until the completion of his contract, shall satisfactorily control and direct the flow of the Ashuelot River and any tributaries at or near the site of the work, so that no part of the permanent construction described in these specifications or shown on the drawings shall be damaged. Diversion of the Ashuelot River shall be accomplished through the tunnel outlet in the west abutment of the dam after the construction of the intake works, gate structure, tunnel conduit and all necessary appurtenances, have been satisfactorily completed and such diversion authorized in writing by the contracting officer. Prior to the authorized diversion, the control of the river shall consist of the temporary diversion during construction (see Paragraph 2-03), and of keeping the river channel free from debris and allowing the river to flow past the site unimpeded.

2-02. Cofferdam for tunnel conduit. - No special cofferdam protection will be required for the excavation and construction of the tunnel conduit. As shown on the drawings, the elevation of the natural ground surface at the tunnel portals is such as to afford sufficient protection. The excavation of the intake and outlet channels must be effected at a low water period. If it becomes necessary to perform this work at any other period a small temporary cofferdam may be required.

2-03. Temporary diversion. - a. Since part of the rolled fill embankment will be constructed before completion of the tunnel conduit, intake and outlet structures, temporary diversion of the Ashuelot River shall be made as shown on the drawings. Provisions shall be made by the contractor during temporary diversion to insure the construction of the dam embankment and the cut-off trench in the dry. The material excavated from the channel made for temporary diversion shall be deposited at the easterly side of the diversion channel.

b. After temporary diversion, as construction of the dam embankment proceeds during the first embankment construction season, dumped rock shall be placed along the toe of the embankment at the end adjacent to the stream and parallel to it, and brought up with the embankment to Elevation 500±. This temporary rock protection for the end of the embankment need not be built in accordance with the provisions of Paragraph 8-02, but shall be built to meet the approval of the contracting officer. After permanent diversion through the tunnel conduit, any dumped rock or other protective material placed within the embankment area for temporary pro-

tection shall be removed and disposed of as directed by the contracting officer.

2-04. Cofferdams for embankment. - a. When the outlet structure, including the tunnel conduit and all other work affected by permanent diversion, shall have been completed to the extent deemed necessary by the contracting officer, and upon written instructions, the contractor shall divert the Ashuelot River through the tunnel conduit by construction of the temporary upstream cofferdam to Elevation 496, and backfill the diversion channel to the original surface elevation.

b. The temporary upstream cofferdam shall be constructed in the location shown on the drawings as an earth dike with top Elevation 496. The requirements for a downstream cofferdam to protect the dam embankment consist of a low earth dike to Elevation 492, as shown on the drawings. Materials from the required excavation, unsuitable for the dam embankment, may be used in the construction of the cofferdams as directed, except for those portions which fall within the limits of the dam embankment; those portions shall be constructed of approved materials in accordance with the drawings and specifications for the dam embankment.

c. After permanent diversion has been effected a supplementary cofferdam shall be constructed to Elevation 513 as shown on the drawings. This cofferdam, located in the area of the dam embankment upstream from the cut-off trench as shown on the drawings, shall be constructed of suitable embankment materials in accordance with the drawings and Sections VI and VIII of the specifications. The contractor shall make provisions to effect satisfactory bond to the previously constructed embankment.

d. Both the upstream and downstream temporary cofferdams shall be located so as not to interfere with the satisfactory preparation of the foundation. All cofferdams shall be built and maintained to the effective elevations specified and to such sections as may be adequate. The contractor shall be responsible for the adequacy of the cofferdam protection to Elevation 496 between the temporary upstream cofferdam and the supplementary upstream cofferdam and to Elevation 513 between the supplementary upstream cofferdam and the downstream cofferdam. The contractor shall be responsible for any damage resulting from failure or washing out of cofferdams because of unsatisfactory construction, provided that damage is not caused by backwater above Elevation 492. The contractor's responsibility stated in this paragraph does not include any damage to the permanent work resulting from overtopping (see Paragraph 2-05). Unless otherwise authorized by the contracting officer, the upstream and downstream temporary cofferdams shall be removed to low-water level when their need is no longer apparent.

2-05. Overtopping. - If the water rises and overtops the diversion dike or cofferdams that have been satisfactorily constructed and maintained to the effective elevations stated above, resulting in injury to the permanent work within the protected area, the contractor shall repair all damages and excavate and replace all damaged permanent work as ordered by

the contracting officer. Payment of the cost of such repairs to the permanent work will be made in accordance with Paragraph 2-06 c.

2-06. Payment. - a. The contract price for Item 1 shall include payment for diversion and care of river during construction, the construction, maintenance, rebuilding in case of destruction, pumping, removal of the diversion dike and downstream cofferdam and maintenance of unobstructed flow through the diversion channel and tunnel conduit. The contract price for Item 1 shall also include payment for placing and removing the temporary dumped rock protection on the end face of the partially constructed dam embankment, and any other temporary protective materials; and shall include all other work required in the diversion and care of the stream during construction not specifically mentioned, including removal and disposal of all debris and trash deposited by floods.

b. Estimates for partial payments for this work will be made as follows: twenty per cent of the contract price for Item 1 when the temporary diversion of the stream has been made; an additional thirty per cent when the river has been diverted through the tunnel and the supplementary cofferdam constructed to Elevation 513; and the remaining fifty per cent when the dam embankment has been completed to Elevation 520, and the protecting works have been removed in accordance with Paragraph 2-04 d.

c. Payment for repairing all damages to permanent work as ordered by the contracting officer will be made at the contract prices for the respective items of work, provided that the damage was not due to any fault or negligence of the contractor. Any damage to the cofferdams and dike, or any temporary protective work shall be replaced by the contractor at his own expense. The contractor shall be responsible for the maintenance and replacement of the diversion dike and upstream and downstream cofferdams until the dam embankment has been completed above Elevation 513, and shall repair without cost to the Government, any damage to the permanent work that may result from his failure to properly maintain the above protective structures.

d. Since the construction of the upstream supplementary cofferdam to Elevation 513 (see Paragraph 2-04 c) is part of the permanent embankment work required and described in Section VI for Item 14, payment for constructing this cofferdam will be made at the contract price stipulated for Item 14 and payment will be allowed for reconstruction in case of washouts by floods.

### SECTION III. CLEARING AND GRUBBING (Item 2)

3-01. Work included. - The contractor shall clear and dispose of all trees, brush, fences, and rubbish, within the limits required, from the site of the spillway channel, main dam, outlet works, access road, spoil areas and other structures appurtenant to the dam. The contractor shall grub and dispose of all stumps, roots and other objectionable materials from the areas within the limits of the foundations of required embankments, a 10-foot strip measured horizontally, beyond and contiguous to the outer toes of the embankment, and any other areas as directed by the contracting officer. Clearing or grubbing in narrow areas or areas for construction roads or other purposes of the contractor will not be included in Item 2.

3-02. Description. - a. The total of the areas to be cleared will not exceed 20 acres. All trees within these areas that measure 12 inches or more in diameter one foot above the ground shall be cut off 12 inches above the ground; smaller trees shall be cut off 6 inches above the ground. Existing stumps not cut under this contract and more than 6 inches in height shall be cut to this height. All stumps decayed to an extent of approximately fifty per cent of their original cross-section, shall be entirely removed. The total area to be grubbed will not exceed 10 acres. All stumps and roots within these areas that measure over two inches in diameter shall be grubbed out for a depth of 6 feet below the ground surface, unless otherwise directed. All other brush and vegetation less than 2 inches in diameter shall be cut flush with the ground surface. Wherever practicable, stumps shall be dug out or removed by stump-pulling machines or other mechanical devices and not by blasting. Holes left by grubbing shall be satisfactorily filled with suitable material.

b. The contractor shall remove and dispose of trees, stumps, brush, roots, and any other objectionable material or structures from within the right-of-way of the access road. No living trees existing outside of the roadway lines shall be cut, unless directed by the contracting officer. The branches of all such trees that are left standing within the right-of-way shall be carefully trimmed. All trees, stumps, and other items removed in excavation for the roadway shall be cut off and grubbed out so that no stumps or roots shall be less than 12 inches below the subgrade surface. Where subgrade embankment is to be made, clearing and grubbing shall conform to Paragraph 3-02 a.

3-03. Disposal of materials. - Acceptable materials obtained by clearing operations may be used in the work. Timber and cord wood obtained from clearing operations and removed buildings, if any, shall become the property of the contractor who shall satisfactorily dispose of these items. The contractor shall burn or otherwise satisfactorily dispose of all trees, brush, and rubbish obtained by clearing and grubbing.

3-04. Measurement and payment. - The contract price for Item 2 shall include payment in lump sum for clearing and grubbing and the satisfactory disposal of all materials resulting therefrom.

SECTION IV. EXCAVATION - OPEN CUT (Items 3 to 9 incl.)

4-01. Classification. - All materials excavated will be classified as follows:

a. Common excavation shall include all earth, clay, sand, gravel and topsoil as defined below, also such hard and compact materials as hardpan, cemented gravel, shale and soft or disintegrated rock that can be removed by hand, power shovels, or draglines without continuous and systematic blasting, and also all boulders and detached pieces of solid rock less than 1 cubic yard in volume.

b. The words "soil" or "topsoil" shall mean the material composing the surface layers of the ground containing varying amounts of organic matter.

c. Rock excavation shall include all solid rock in place that cannot be excavated by hand, power shovels, or draglines without continuous and systematic blasting, also all boulders or rock fragments 1 cubic yard or greater in volume.

d. Detailed classification is as follows:

- (1) Stripping (see Paragraph 4-02).  
Common Stripping (Item 3)
- (2) Common Excavation (see Paragraphs 4-03, 4-04 and 4-05).  
General (Item 4)  
Borrow Pit (Items 5 and 6)  
Cut-off Trench (Item 7)
- (3) Rock Excavation (see Paragraph 4-06).  
Open Cut (Item 8)
- (4) Line Drilling and Broaching (Item 9) (see Paragraph 4-07).

4-02. Stripping (Item 3). - a. Work included. - (1) The contractor shall strip the area to be covered by the dam embankment to a sufficient depth to remove all materials not suitable for the foundation of the embankment as determined by the contracting officer. The unsuitable materials to be removed shall include topsoil, rubbish below the ground surface not removed by clearing and grubbing, all loose rock and any other objectionable material.

(2) Topsoil obtained from the stripping operations shall be stockpiled in an approved location to be used later in landscaping, unless otherwise authorized by the contracting officer.

b. Description. - The areas occupied by the dam embankment, together with strips 10 feet wide beyond and contiguous to the toe line on either side as indicated on the drawings, shall be stripped. The rock stripping shall be removed in any convenient manner, except that blasting shall be restricted to light charges for the breaking up of boulders or

large fragments, as directed by the contracting officer. The contractor will be paid for rock excavation for that material which comes within the definition of rock (see Paragraph 4-01 c), at the unit contract price for Item 8.

c. Disposal of materials. - All suitable materials excavated under Item 3 shall be deposited in an approved manner, at designated locations in the ordered embankments. Excavated materials not used in such embankment construction may be used by the contractor in the construction of cofferdams or protection levees, or as directed by the contracting officer shall be disposed of otherwise in designated spoil areas (see Paragraph 4-02 a (2)).

d. Measurement and payment. - (1) The quantities to be paid for under Item 3 will be the number of cubic yards excavated and satisfactorily disposed of in accordance with drawings or orders, measured as specified in place before excavation. Payment will be made at the unit contract price for Item 3.

(2) Prior to the commencement of work under this contract a survey of the site area of the specified work will be made and the surface as determined by this survey will form the basis for the measurement of all quantities. All stripping and excavation quantities will be measured between the surfaces determined by this survey and the slope and grade lines shown on the drawings or otherwise established by the contracting officer. The slope lines shown on the drawings do not represent the actual slopes to which the excavation must be made to safely perform the work; the actual slopes may be greater or less than those indicated, depending upon the materials excavated and methods used in performing the work, but such changes will not alter the basis of measurement as specified above. Where rock is encountered in common excavation or stripping, a survey will be made to determine the surfaces of such rock. Common excavation and common stripping will be measured above the rock surfaces so determined. If rock excavation is required, such quantities will be measured below the rock surfaces so determined. No payment will be made for rock excavation except where the original surface has been determined by the aforementioned survey. Rock excavation will be measured to Payment Line "A" where shown on the drawings, to neat lines of structures where line drilling and broaching of rock faces are required, and elsewhere to slope and grade lines as ordered by the contracting officer to reach sound rock. No payment will be made for common or rock excavation outside of the limits described above; the contractor will be required to backfill any such excess excavation with approved material, or with concrete where excavated surfaces are in contact with concrete structures, at his own expense. Payment for excavation will be made at the respective contract prices for the various items of work as described under each classification.

4-03. Common Excavation - General (Item 4). - a. Work included. - (1) The contractor shall excavate and dispose of the materials classified as common excavation above and below the mean water level in the river to the lines and grades shown on the drawings for the respective areas.

or as otherwise ordered by the contracting officer. Common excavation shall be done in the intake approach channel for the spillway weir and in the spillway channel. Common excavation includes excavation for structures, and the materials required for the excavating and grading of the toes of the dam embankment in addition to the work included in Items 2 and 3, for the excavating of gravel bars in the river-bed, and any other ordered common excavation not included in other items of the work.

(2) Neither the location of the rock surface nor the depth of overburden can be known with certainty until the rock surface is fully exposed by the construction operations. The shattered rock and loose boulders encountered in the common excavation which will be classified as rock in accordance with the definition of rock (see Paragraph 4-01 c) shall be excavated and disposed of and paid for as rock. The ordered lines and grades shall include any necessary adjustment to field conditions.

b. Shoring. - The contractor shall be responsible for the unfinished work, and that workmen shall be safe from danger of caving or slides while making structure excavations. Shoring may be used at the option of the contractor. If shoring is necessary and the contractor does not use it, its use will be ordered by the contracting officer. Subject to the approval of the contracting officer, shoring shall be erected in a safe and workman-like manner, and shall be placed in such a way as to afford ready inspection of and ample clearance for the permanent work. Shoring shall be removed as directed by the contracting officer, upon completion of the permanent work or as soon as the construction does not require its use.

c. Disposal of Materials. - As directed by the contracting officer all suitable materials excavated under Item 4 shall be placed in the ordered embankments or miscellaneous fills. Excavated materials not used in embankment construction may be used by the contractor in the construction of cofferdams or protection levees if approved by the contracting officer or shall be disposed of otherwise in designated spoil areas. The excavation from the intake approach channel shall be side-casted (see Paragraph 2-03).

d. Measurement and payment. - See Paragraph 4-05 d.

4-04. Common Excavation - Borrow Pit (Items 5 and 6). - a. Work included. - The contractor shall excavate to the ordered lines and grades in any approved borrow pit, and transport the additional material required for the dam embankment or other miscellaneous fills, which is not included in other excavation items. Borrow pit excavation shall include the clearing of the pits and the stripping and disposal of objectionable topsoil containing roots or other debris, and the removal and the disposal of any other objectionable material so designated by the contracting officer. To provide suitable embankment materials excavations shall be made to the depths and in the locations as directed by the contracting officer. During and after excavation the borrow pit areas shall be so graded that all surface water will readily drain from them. The borrow pits shall be left in

a neat condition satisfactory to the contracting officer.

b. Description. - (1) Under Item 5 shall be included the excavation from borrow pits "A", "B", "C" and "E" shown on the drawings and located not over 2,000 feet distant from the dam embankment. Borrow pits "B" and "E" shall be considered as alternates and excavation therefrom may not be required. The limit of excavation in the vicinity of the abutments of the dam shall be that expressly directed by the contracting officer, and sufficiently distant from the abutments as not to endanger the safety of the embankment. No borrow pit excavations will be permitted within 300 feet of the dam embankment. Excavations shall be made to the depths and in the locations approved by the contracting officer so as to provide the necessary embankment or fill materials in the proper sequence for construction purposes.

(2) Under Item 6 shall be included the excavation from borrow pit "D" shown on the drawings and located in the valley about 1-1/2 miles upstream from the dam embankment. Excavation from borrow pit "D" will be required to provide the selected pervious fill (Item 15), and may be required for other embankment items. Excavations shall be made to the depths and in the locations approved by the contracting officer so as to provide the necessary embankment or fill materials in the proper sequence for construction purposes.

(3) On the lands controlled by the Government at places directed by the contracting officer, as shown on the drawings, the contractor shall obtain suitable material for construction by opening quarries for rock, and borrow pits for gravel, sand and soil. He shall also secure suitable material for construction from required excavations for structures. Work in the borrow pits shall be done with reasonable neatness, and the contractor shall confine his operations to approved locations limited as required in number and extent. If the contractor desires to use areas from which the contracting officer has not previously secured and tested samples, he shall dig test pits and furnish samples to the contracting officer in sufficient time in advance of use to permit determination of suitability. Unless otherwise directed, the contractor shall utilize all suitable materials encountered in the required excavations for the permanent work.

(4) The contractor shall inform the contracting officer of the locations in the borrow areas in which he intends to work a sufficient time in advance so that the contracting officer can make additional investigations of the materials without delay to the contractor. The contractor shall furnish all labor and construction equipment that is necessary to prepare for taking the samples and shall furnish labor to assist the contracting officer to take the samples.

c. Shoring. - The provisions of Paragraph 4-03 b shall apply.

d. Disposal of materials. - The provisions of Paragraph 4-03 c shall apply.

c. Measurement and payment. - See Paragraph 4-05 d.

4-05. Common Excavation - Cut-off Trench (Item 7). - a. Work included. - The contractor shall excavate and dispose of the materials in the cut-off trench under the dam embankment both above and below the mean water level in the river to the lines and grades shown on the drawings, or otherwise ordered by the contracting officer. The required depth of the cut-off trench at all points cannot be known with certainty until the area is fully developed by the construction operations. The ordered lines and grades shall include any necessary adjustment to field conditions.

b. Pumping and draining. - The contractor shall do all pumping and draining necessary to perform the excavation in the dry, and to keep the cut-off trench unwatered until it has been satisfactorily back-filled with suitable embankment material.

c. Disposal of materials. - The provisions of Paragraph 4-03 c shall apply.

d. Measurement and payment. - The quantities to be paid for under Items 4 to 7 inclusive shall be the number of cubic yards excavated and satisfactorily disposed of in accordance with the drawings or orders. Quantities will be measured in place before excavation. The unit contract prices for the respective items shall include all costs of shoring and other incidental work. The unit contract prices for Items 5 and 6 shall include all costs of clearing, stripping and shoring in the borrow pit areas defined in Paragraph 4-04 b (see Paragraph 4-02 d (2)).

4-06. Rock Excavation (Item 8). - a. Work included. - The contractor shall excavate and dispose of the rock excavated above and below the mean water level in the river to the lines and grades shown on the drawings or otherwise ordered by the contracting officer (see Paragraph 4-03 a). Rock excavation shall be done in the intake approach channel, for the spillway weir and the spillway and outlet channels, and to scale and trim the bottom or side slopes of open-cut excavations not included in Line Drilling and Breaching (Item 9). Rock excavation under Item 8 shall include any other ordered rock excavation in open cut not included in other items of the work.

b. Shoring. - The provisions of Paragraph 4-03 b shall apply.

c. Blasting. - (1) Blasting and the use of explosives shall be conducted as provided for in Paragraph 1-26.

(2) Blasting will be permitted only when proper precautions are taken for the protection of all persons, the work and the property. All damage done to the work or the property shall be repaired by the contractor at his own expense. All operations of the contractor in connection with the transportation, storage, and use of explosives shall be as approved by the contracting officer. The contractor shall be liable for all injuries or deaths of persons or damage to property caused by the blasting operations.

(3) All necessary precautions shall be taken to preserve the rock outside the lines of excavation in the soundest possible condition. Explosives of such quality and power shall be used in the locations which will, in the opinion of the contracting officer, neither crack nor damage the rock outside the lines of excavation. Blasting shall be done only to the lines and grades shown on the drawings or approved by the contracting officer. All rock removed beyond the lines and grades shown on the drawings or approved by the contracting officer shall be replaced at the expense of the contractor by suitable material, as directed by the contracting officer.

(4) Heavy blasting shall not be done against rock which will form the final foundation. The foundation shall be prepared by drilling, picking, barring, wedging, or similar methods which will leave the rock of the foundation in a solid and unshattered condition. Where required by the contracting officer, the rock shall be cut into rough stops or benches, to provide better bond and bearing surfaces. To aid inspection and to insure good bond with the concrete, the foundation shall be thoroughly cleaned by streams of water or jets of air, or a combination of both, or by wet sand-blasting, as required by the contracting officer.

(5) Approval by the contracting officer of the method of blasting or the strength and amount of the explosive used, will not relieve the contractor of his responsibility in the blasting operations. Care shall be taken not to over-shoot at the junction of the tunnel outlet with the spillway channel (see Paragraph 4-07 b).

(6) Generally, the faces of rock excavations shall be sealed to a tolerance not exceeding 1 foot each way from the designated payment-line shown on the drawings.

d. Disposal of materials. - The provisions of Paragraph 4-03 c shall apply to Item 8. Some stock piling may be necessary (see Paragraph 5-02 d).

e. Measurement and payment. - The quantity to be paid for under Item 8 will be the number of cubic yards excavated and satisfactorily disposed of in accordance with the drawings or as ordered. Quantities will be measured in place before excavation. Where payment-line A is shown on the drawings, the quantities to be paid for will be the quantities measured to Line A. The unit contract price shall include the cost of the disposal of all excavated materials, and for shoring or other incidental work (see Paragraph 4-02 d (2)).

4-07. Line Drilling and Broaching (Item 9). - a. Work included. - The contractor shall line-drill and broach the vertical faces of rock excavation for key walls and in the spillway channel adjacent to the tunnel outlet and sloping faces of the intake and outlet channels at the locations indicated on the drawings, or as otherwise directed by the contracting officer.

b. Description. - The spacing of holes and method of drilling

shall be determined by the field conditions as the work progresses, and as approved by the contracting officer. Blasting operations shall be performed so as not to fracture the rock beyond the line of drill holes. The rock face shall be scaled to a tolerance not exceeding 3 inches each way from the line of drill holes. At the junction of the tunnel outlet with the spillway channel special attention is required to preserve the minimum thickness of sound unexcavated rock as shown on the drawings, between the tunnel and spillway channel.

c. Measurement and payment. - The quantity to be paid for under Item 9 will be the number of square feet of rock surface satisfactorily prepared at the locations shown on the drawings or in accordance with orders. The unit contract price shall include payment for all materials, labor, plant, tools and all expenses necessary to do the work included in Paragraph 4-07 a (see Paragraph 4-02 d (2)).

SECTION V. EXCAVATION-TUNNEL AND GATE SHAFT (Items 10 to 12 incl.)

5-01. Classification. - The work to be done is classified as follows:

a. Rock Excavation (see Paragraph 5-02)

- (1) Tunnel Excavation (Item 10)
- (2) Gate Shaft Excavation (Item 11)

b. Timbering (Item 12) (see Paragraph 5-03)

5-02. Rock Excavation (Item 10 and 11). - a. Work included. - (1) Tunnel excavation shall include all excavation in the tunnel between the intake and outlet portals as indicated on the drawings, and below approximate Elevation 498 at the gate shaft. The location of the intake structure and outlet portal will depend upon the position and soundness of the ledge rock. If these conditions cannot be determined prior to the actual opening up of the excavation work for the intake and outlet channels, the locations of these structures will be adjusted to field conditions when the open-cut excavation has progressed sufficiently to furnish the necessary information. The limits of the tunnel excavation, Station 7 + 50.5 approximately and Station 11 + 28 approximately are tentative, but they serve to fix the relation of these limits to adjacent structures.

(2) The shaft excavation shall include all rock excavation in the gate shaft between Elevation 498 approximately and Elevation 548 approximately and within the limits fixed by the "A" lines, as indicated on the drawings.

b. Description. - The contractor will be permitted to excavate the tunnel and gate shaft by any approved method, provided that the work of excavating is carried on continuously so far as practicable until the completion of the excavation. The contractor shall drain and properly light and ventilate the tunnel and shaft during construction.

c. Blasting. - Blasting shall be done in accordance with Paragraph 1-26 and Paragraph 4-06 c.

d. Disposal of materials. - As directed by the contracting officer all suitable materials excavated under Items 10 and 11 shall be placed in the permanent work, in stockpiles or wasted. Excavated materials not suitable for use in the permanent structures may be used by the contractor in the construction of cofferdams or protection levees if approved by the contracting officer or shall be disposed of otherwise in designated spoil areas.

e. Measurement and payment. - The quantities to be paid for under Items 10 and 11 will be the number of cubic yards excavated and satisfactorily disposed of including any required wasting or stockpiling, in accordance with the drawings or orders. Quantities will be measured

in place before excavation. Rock excavation to be paid for will be to the grades and to the pay line "A" shown on the drawings.

5-03. Timbering (Item 12). - a. Work included. - The contractor shall furnish and install all necessary timbering to support safely the roof of the tunnel and the sides of the tunnel and shaft. Timbering shall be done at such places as the contracting officer directs with approved materials and in an approved manner. Nothing in this paragraph shall prevent the contractor from installing at his own expense such other timbering as he considers necessary nor shall the contractor be relieved from responsibility for the safety of, injury to, or deaths of persons employed on the tunnel and shaft work. As directed by the contracting officer all or part of the timbering shall be removed before the lining is placed.

b. Measurement and payment. - Payment for all timber installed as directed by the contracting officer including the removal of such timber as the contracting officer directs will be for the number of thousand feet board measure installed. The unit contract price for this item shall include all bolts, nuts, washers or other hardware necessary to properly construct and install the timbering.

SECTION VI. ROLLED EMBANKMENT (Item 14)

6-01. Definitions. - The term "rolled embankment" as used in these specifications includes earth fill of all types for the dam and cut-off trench, and all other specified or directed earth fills within the limits of the dam necessary to complete the rolled embankment. As shown on the drawings, the various types of earth fill are "selected impervious" for the cut-off trench and core of the embankment; "random impervious" adjacent to the core of the embankment on both upstream and downstream sides of the core; and "pervious" forming the upstream and downstream shoulders of the embankment; including that portion of the embankment under the access road on the east side of the spillway channel.

6-02. Work included. - a. The contractor shall place, grade and consolidate materials required for the rolled embankment, to the elevation, lines, grades and cross sections shown on the drawings with such increased height and width as may be deemed necessary by the contracting officer to allow for later shrinkage or settlement. The contractor shall use suitable materials as selected by the contracting officer from the required excavations and borrow pits shown on the drawings.

b. The contractor shall install settlement gages and water-table indicators of the dimensions shown and at the locations shown on the drawings.

6-03. Materials. - a. All materials from required excavations will be used, if, as excavation proceeds, they are found suitable by the contracting officer for use in the embankment. Brush, roots, sod, any type of organic materials, and other perishable or unsuitable material as determined by the contracting officer shall not be placed in the embankment. Materials shall not be wasted except by specific instructions from the contracting officer.

b. Other suitable materials shall be borrowed from locations shown on the drawings in accordance with Paragraph 4-04. The origin of any material from either structure or borrow excavations does not definitely determine where it will be used in the embankment. Materials from two or more excavation or borrow areas may be required to be used at the same time and in the same part of the embankment, mixing being done in the process of placing by systematic dumping, spreading and bulldozing. Materials from one area may be required to be used in different parts of the embankment.

6-04. Plowing. - Immediately prior to the placing of materials in the embankment, and after stripping has been completed (see Paragraph 4-02), the entire foundation of the embankment, except on exposed rock, shall be thoroughly plowed and broken to a depth of 8 inches, wherever practicable in the opinion of the contracting officer. The furrows shall run approximately parallel to the axis of the dam embankment. All roots, stones, and debris or other objectionable material shall be removed and burned or spoiled, as directed by the contracting officer. The condition

of the surface material of the foundation area at the time of plowing shall be slightly drier than the required moisture content for rolled embankment. The requirements for plowing do not apply to the side slopes of the cut-off and toe trenches, and stump holes. After plowing, the entire surface of the foundation area shall be rolled in accordance with Paragraph 6-06 d.

6-05. Filling of excavations in embankment area. - a. General. - The cut-off trench, test pits, stump holes and other excavated areas within the limits of the embankment and as otherwise shown on the drawings shall be filled with pervious, random or impervious materials as directed by the contracting officer. The material for the fills shall be secured from approved borrow areas or required excavations. The fill shall be placed in layers, moistened, and rolled in accordance with Paragraph 6-06, whenever, in the opinion of the contracting officer, it is possible to do so. Material which cannot be compacted by roller equipment on account of clearances, shall be spread in 4-inch layers and compacted with power tampers which shall give the degree of compaction required for the embankment. As the fill is brought up, the side slopes of the cut or hole shall be scarified by equipment or by hand if it is required, in the opinion of the contracting officer, in order to provide a bond between the fill and the original ground material.

b. Stump holes. - The sides of stump holes shall be broken down with bulldozers or a disc harrow so as to flatten out the slopes, and the hole then filled with approved material and properly rolled or tamped in place.

c. Cut-off trench. - The fill for the cut-off trench shall be placed in the dry and rolled in accordance with Paragraph 6-06. The water shall be drained to a sump and removed, working the materials toward the sump and sloping the surface of the fill longitudinally toward the sump. Well points or other suitable means may be used for drying up the foundation at the contractor's option. That section of the cut-off trench which is excavated to rock shall have its foundation thoroughly cleaned of sand, gravel, and loose pieces of shattered or broken rock before any fill is placed (see Paragraph 4-02).

6-06. Rolled fill. - a. General (1) As soon as the cut-off trench has been filled, the selected impervious, random impervious, and pervious sections of the embankment shall be brought up to a crown running with the center line of the dam and with slopes approximately on a 2 per cent grade toward the edges of the embankment. This slope shall be maintained until the completion of the embankment, thus constructing the impervious, random impervious and pervious sections in the same plane. As soon as practicable, in the opinion of the contracting officer, the embankment will be brought to a nearly uniform grade for the entire length.

(2) The construction of the embankment will be started before permanent diversion of the river and a temporary diversion channel and temporary protective works shall be constructed to protect the embank-

ment (see Paragraph 2-03) and to facilitate placing of the upstream toe in the dry. Unless otherwise directed by the contracting officer, the end slope of the embankment shall be 1 on 2.

b. Furnishing and placing. - (1) The contractor may use power shovels, drag lines, or any type of excavating machinery which is capable of excavating the materials in dry condition. The contracting officer reserves the right to specify the location in the borrow pits and the depth to which excavation shall be made. The contractor may use any approved method of transporting materials in natural dry condition. The dumping of the successive loads from the borrow pits, or required excavations on the embankment, shall be at locations as directed or approved by the contracting officer. Sufficient excavating and hauling equipment shall be available so that not less than two sources of material can be worked at the same time. When two or more different materials are being moved into a section of the embankment they shall be spotted and dumped systematically so that in any area of the section they are approximately the required proportions of the materials. After dumping, the materials for the impervious and random impervious sections shall be bulldozed or otherwise spread in layers approximately 6 inches in thickness after rolling (see Paragraph 6-06 d). The pervious material shall be spread in layers 8 to 12 inches in thickness after rolling as determined by the contracting officer and rolled (see Paragraph 6-06 d). Should the material for the various sections of the embankment be too high in water content when dumped, it shall be bulldozed or otherwise spread in 6-inch layers and left for a sufficient time to allow the surplus water to dry out before being rolled. If, in the opinion of the contracting officer, the rolled surface of any layer of the random impervious and impervious materials is too smooth to bond properly with the succeeding layer or, if the materials have dried out sufficiently to cause cracks in the surface, it shall be roughened or loosened by a disc harrow, or other approved means, to the satisfaction of the contracting officer, and dampened, if required, before the succeeding layer is placed thereon. All roots, trash, and debris shall be promptly removed from the embankment and disposed of to the satisfaction of the contracting officer. Stones greater than 6 inches in diameter shall be removed from the impervious and random impervious sections and when approved by the contracting officer, shall be placed in the rock sections of the embankment. The entire surface of the embankment shall at all times be maintained in such condition that construction equipment can travel thereon. Routing of construction equipment on the embankment shall at all times be subject to direction by the contracting officer.

(2) Any embankment material lost or loosened, after being placed in the embankment and before the completion of the contract and acceptance of the completed work, because of floods or other actions of the river, any operation of the contractor or for other causes that in the opinion of the contracting officer were avoidable or under the control of the contractor, shall be replaced by the contractor to the satisfaction of the contracting officer and without cost to the Government, except as provided in Paragraph 2-05.

(3) The contractor shall cease work on the embankment at any time when, in the opinion of the contracting officer, satisfactory work cannot be done on account of rain, high water, cold weather, or other unsatisfactory conditions.

c. Moisture control. - In order to obtain the desired degree of compaction, the materials when rolled shall have the optimum moisture content practicable for the type and gradation of materials available, and it shall be uniformly distributed throughout the layer. If required, the compacted surface shall be sprinkled as directed immediately before placing each new layer. The moisture content shall be sufficient to dampen the filled materials as required, but the amount of sprinkling shall be controlled so that no free water will appear on the surface during or subsequent to the rolling. An adequate supply of water shall be available at all times, and jets shall not be directed at the embankment material with such force that the finer materials are washed out.

d. Compaction. - (1) Tamper type roller. - Rolling for the impervious and random impervious sections of the embankment shall be done by a tamper type twin roller such as a "sheeps-foot" roller, water or sand ballasted, having tamping foot uniformly staggered over its cylindrical surface, and equipped with cleaners; or other satisfactory type of tamper roller as approved by the contracting officer. Each tamping foot shall project approximately 7 inches from the roller's cylindrical surface and shall have a face area of not less than 5 and not more than 7 square inches. Provision shall be made for an increase or reduction in the number of tamping foot as required by the contracting officer. The total weight of the roller in pounds divided by the total area of the maximum number of tamping feet in one row parallel to the axis of the roller shall not be less than 300 pounds per square inch tamping foot area with the drum ballasted. The design and operation of the tamping roller shall be subject to the approval of the contracting officer.

(2) Rolling impervious and random impervious section. - When the moisture content and condition of the spread layers are satisfactory to the contracting officer, the contractor shall roll the impervious and random impervious sections of the embankment with tamper type twin rollers. The twin rollers shall be pulled by a crawler type tractor of suitable power, weighing not less than 20,000 pounds, manufacturer's standard weight, at a speed of approximately 2-1/2 miles per hour. Each square foot of each layer of the embankment material shall be compacted by not less than six passes of the rollers, and ordinarily not more than nine passes as required by the contracting officer. Successive trips of rollers need not overlap, but the spaces between trips shall be no greater than the space between the adjoining feet on the roller. Failure to comply with this requirement for careful rolling will be a cause for additional trips at the contractor's expense. Where new material abuts old material, either in place or in embankment, the old material shall be cut or broken by machine or hand methods approved by the contracting officer, until it shows the characteristic colors of undried materials, and the rollers shall work on both materials, bonding

them together. Portions of the earth fill which the roller cannot reach for any reason shall be thoroughly compacted by tamping with power tampers in 4-inch layers. The degree of compaction for such portions of the earth fill shall be equivalent to that obtained by sprinkling and rolling as specified for the other portions of the earth fill.

(3) Rolling pervious section. - Rolling of the pervious sections of the embankment shall be the same as specified above except that a minimum of 3 and a maximum of 6 passes of the rollers will be required. If, in the opinion of the contracting officer, proper compaction can be obtained by the use of a plain cylindrical roller, or a Parson's disc tamping roller, the use of such a roller may be required. The roller shall weigh not less than 1100 pounds per linear foot. When conditions of the work so require, at the direction of the contracting officer, rolling may be done by a crawler type tractor weighing not less than 20,000 pounds; in such cases a maximum of six passes of the tractor treads on each square foot of embankment area will be required.

(4) Tests for compaction. - Samples of all embankment materials for testing, both before and after placing and compaction, will be taken by the contracting officer at frequent intervals and from these tests, corrections, adjustments and modifications of methods, materials, and moisture content will be made in order to secure the maximum practicable density of the materials in the dam embankment.

e. Impervious fill. - Impervious fill will be selected and secured from required excavations and borrow pits "A" or possibly "E" and "B" as directed by the contracting officer, and shall be placed in the select impervious section of the embankment throughout the entire length.

f. Random impervious fill. - Random impervious fill will be selected and secured from required excavations and borrow pits "A" or possibly "E" as directed by the contracting officer, and shall be placed in the random impervious sections of the embankment. In general this material shall be placed so the coarser portions are toward the outside edge, and the finer portions near the select impervious section, so that a gradational transition is effected from the impervious to the pervious section.

g. Pervious fill. - The pervious fill will be selected and secured from required excavations and borrow pits "C" and "D" as directed by the contracting officer, and shall be placed in the pervious sections of the embankment. The pervious sections of the embankment shall be graded from the finer materials near the random sections to the coarser materials near the outer faces of the embankment. Special care shall be taken to place the coarser material and cobbles adjacent to the outer faces of the embankment.

6-07. Removal of objectionable material. - The contractor shall, when directed by the contracting officer, excavate, remove and dispose of any material from the embankment sections which the contracting officer considers objectionable in such locations, and refill the area as

directed in accordance with Paragraph 6-05.

6-08. Slides. - In case of slides in any part of the embankment during the construction or after completion, but prior to the final acceptance of the work, the contractor shall cut out and remove the area specified by the contracting officer and then rebuild the excavated area in accordance with these specifications. In case it is determined that the slide is caused through the fault of the contractor, the foregoing shall be performed at no cost to the Government.

6-09. Frozen materials. - No earth shall be placed upon a frozen surface, nor shall frozen earth, snow or ice be placed in the embankment. In cases of emergency the contracting officer may require frozen material to be stock-piled for later use in the embankment.

6-10. Shrinkage or settlement of foundation. - The contractor shall assume all responsibility for placing excess embankment material required by shrinkage during construction insofar as payment for fill in embankment is concerned as such quantities are not deemed determinate. The Government will assume responsibility for all increased quantities of materials in the embankment required by foundation settlement. All determinations for foundation settlement will be based on settlement gages (see Paragraph 6-11). The amount of increased quantities due to settlement will be determined by the contracting officer after the embankment is completed and his decision shall be final. Excavation of excess materials from the borrow pits required by settlement and shrinkage will be paid for at the contract prices for the respective contract items.

6-11. Settlement gages. - a. In accordance with Paragraph 6-02 b, foundation settlement gages shall be furnished and installed by the contractor. The gages shall be installed in such a manner that at no time will the top of the gage pipe be closer than 18 inches below the top surface of the embankment. Upon completion of the final course over each gage, the final section of pipe shall then be brought to an elevation 12 inches above the embankment surface. Ordinarily the method of installation shall be as follows: after the embankment has been brought up to a height of 6 feet, shafts shall be excavated at the location shown on the drawings and to such a depth as to insure that the base plates are placed on a level area of undisturbed ground at the bottom of the plowed furrows. The base plate with attached section of pipe shall be placed and the pipe capped. The backfill will then be brought up to the top of the shaft in two-inch tamped layers in accordance with Paragraph 6-06 d(2). Gravel will be used for backfilling the perforated portion of the pipe only. Shafts through succeeding 5-foot increments of embankment will be excavated and sections of gage pipe attached. In all cases the shafts shall be backfilled in 4-inch tamped layers. Shaft excavation shall be used for shaft backfill unless otherwise ordered.

b. Payment for furnishing and placing the metal base plates and pipe for the gages will be made at the contract prices for Items 43 and 45 (see Paragraph 16-09b). Payment for placing the backfill will be

made at the contract price for Item 17 (see Paragraph 7-04).

6-12. Temporary drains and ditches. - The contractor shall maintain the site of the work and the grounds immediately adjacent thereto, free from collected surface water, if, in the opinion of the contracting officer such collected water affects the safety or condition of the work. Such temporary drains and ditches shall be constructed as are deemed necessary and directed by the contracting officer.

6-13. Filling unauthorized excavations. - If the contractor excavates anywhere outside the ordered limits or below the ordered grades without permission, he shall refill such excavations at his own expense with acceptable materials placed as directed by the contracting officer.

6-14. Measurement and payment. - a. The quantity to be paid for under Item 14 will be the number of cubic yards placed between the foundation surfaces prepared as described herein and the slope lines and grades as shown on the drawings or as modified by the contracting officer, except as otherwise provided. The unit contract price shall include payment for preparing the base, placing materials, spreading in layers, wetting rolling or tamping, trimming to line, and shall include all labor and materials incidental to satisfactorily completing the embankment, not specifically included for payment under other items.

b. Payment will be made to the contractor to replace embankment washed out by flooding or overtopping of cofferdams (see Paragraph 2-06 d), or required by slides, or the removal and disposal of all objectionable materials placed at the direction of the contracting officer, provided such replacement of embankment was not caused by negligence or carelessness of the contractor, or by inadequate construction of cofferdams to the specified effective elevations (see Section II). Payment for replacement of embankment will be at the unit contract price for Item 14; payment for any necessary excavation preliminary to replacement of embankment will be at the unit contract price for Item 4. The quantities to be paid for will be the number of cubic yards for the respective items of work measured as the contracting officer may direct.

SECTION VII. MISCELLANEOUS FILL AND BACKFILL (Items 15 to 19 incl.)

7-01. Definitions. - The term "selected pervious fill" includes the gravel blanket immediately underlying the various items of rock fill and riprap as shown on the drawings and the gravel required for filters. "Unclassified fill" is confined to the access road on the west side of the spillway channel. "Compacted backfill" is generally structure backfill behind retaining walls and structures as shown on the drawings. "Gravel for roads" includes material required for the access road and for the road across the top of the dam. "Semi-compacted backfill" refers to miscellaneous backfill not completely compacted.

7-02. Selected pervious fill (Item 15). - a. Work included. - As shown on the drawings or as directed the contractor shall place, on the upstream and downstream slopes of the dam ombankment, a layer of selected pervious fill upon which the rock fill will be placed. The contractor shall also place a layer of selected pervious fill of the specified quality as a foundation for the riprap which will be placed at the tunnel intake and spillway approach, and at other locations shown on the drawings or as directed by the contracting officer.

b. Materials. - Selected pervious fill shall consist of suitable coarse, clean, well-graded gravel of which, unless otherwise directed not more than ten per cent by weight will pass a No. 10 sieve. The material shall be obtained from approved borrow pits, be screened, and placed directly in position and consolidated by wetting to the extent directed.

c. Placing. - The material shall be placed as shown on the drawings or as directed, and with such hand-placing as may be necessary to trim to the required slopes. The contractor will not be required to tamp or roll the material, but will be required to consolidate it with water to the extent directed so that no settlement or voids will later result.

d. Measurement and payment. - The quantity to be paid for under Item 15 will be the number of cubic yards placed to the limits shown on the drawings, or ordered. Payment will be made at the unit contract price for Item 15.

7-03. Fill (unclassified) - Access road (Item 16). - a. Work included. - The contractor shall furnish, place, grade, and consolidate suitable materials required for the subgrade fills of the access road, to the elevations, lines, grades, and cross sections shown on the drawings.

b. Materials. - As directed by the contracting officer, suitable materials shall be obtained from the required excavations for the access road adjacent to the required subgrade fills as shown on the drawings. Additional suitable materials required for the subgrade fills shall

be obtained from borrow pits shown on the drawings or designated by the contracting officer.

c. Placing. - Subgrade fills shall be formed of suitable materials obtained from the required excavation and shall be placed in successive layers of not more than twelve inches in depth for the full width of the cross section, each layer to be rolled thoroughly with a three-wheel power roller weighing not less than ten tons. Stumps, trees, rubbish or other unsuitable materials shall not be placed in the fill. If the bottom of the fill is of insufficient width to permit the use of the roller, the material shall be compacted in a manner satisfactory to the contracting officer. If the angle of the slope of the original surface of the ground, measured at right angles to the center line of the fill, is greater than thirty degrees from the horizontal, the original surface shall be thoroughly broken up and formed into steps from four to six feet wide for the full width of the fill as directed by the contracting officer. Rock used for fill shall be evenly and uniformly distributed across the fill. Coarse rock shall be carefully placed and the voids filled with spalls, and covered with run-of-pit gravel or earth so as to form a solid fill. Rock larger than four inches in greatest dimension shall not be placed less than six inches below the final subgrade. The contractor shall be responsible for the stability of the road fill.

d. Subgrade. - During the construction of the subgrade, the road bed shall be maintained in a well-drained condition. All muck, quicksand, soft clay, or other material unsatisfactory for the subgrade shall be removed to such depth as the contracting officer may direct. Rock excavation shall extend to at least one foot below the grade but not exceeding two feet, except for ditches, culverts, structure foundations, and steps excavated on steep slopes to secure stability for fills. Wherever rock foundation is not over two feet below grade elevations, the subgrade shall be brought to grade by covering the rock with gravel or other suitable material obtained from the required excavation.

e. Grading. - The road shall be graded in accordance with the cross sections and profile indicated on the drawings or as directed by the contracting officer. All shoulders, ditches, and side slopes, whether excavation or fill, shall be trimmed and dressed in a neat and workmanlike manner, to the lines and grades indicated on the drawings or as staked in the field. The sub-base upon which the gravel base course will be placed, shall be shaped to a uniformly even and regular grade in accordance with the lines and grades indicated on the drawings or as staked in the field, and compacted to the satisfaction of the contracting officer.

f. Blasting. - Blasting shall be done in accordance with Paragraph 1-26 and Paragraph 4-06 c. All necessary precautions shall be taken to preserve the rock outside the lines of excavation in the soundest possible condition.

g. Disposal of materials. - All suitable materials excavated under Item 16 shall be placed, in an approved manner, at locations designated in the ordered fills. Excavated materials not used in road fill construction shall be disposed of in approved spoil areas.

h. Measurement and payment. - (1) The quantity to be paid for under Item 16 will be the number of cubic yards furnished and satisfactorily placed in accordance with drawings or orders. Quantities will be measured in place after compacting. The unit contract price shall include payment for all excavation except rock required for the subgrade of the access road, borrow excavation and haul, satisfactory disposal of all unsuitable excavated materials, grading, ditching and draining, and any work incidental thereto. Rock excavation will be paid for under Item 8.

(2) To determine the quantities for which payment will be made, a survey will be conducted prior to the beginning of the placing of the fill. The true surface condition will be shown by cross sections and profile and the measurement of the quantities will be based upon this survey. The quantities will be the volume between the original surface at the beginning of the work and the slope lines and grades at the completion of the work. The slope and grade lines will be as indicated on the drawings, as staked in the field, or as directed by the contracting officer.

7-04. Compacted backfill (Item 17). - a. Work included. - The contractor shall place, grade and consolidate materials required for backfill of retaining walls at the westerly end of the dam, and in consolidated embankments elsewhere as directed, except those required under other items.

b. Borrow. - Materials shall be borrowed from locations shown on the drawings in accordance with Paragraph 4-04, or may be obtained from required excavations. Backfill material shall be free from stumps, roots, sod, rubbish or other unsuitable materials or substances.

c. Placing. - The backfilling shall be placed and compacted as specified in Paragraph 6-06d(3), and graded and trimmed to the required lines and grades.

d. Measurement and payment. - The quantity to be paid for under Item 17 will be the number of cubic yards placed in accordance with orders, measured in place after compacting. The unit contract price shall include payment for placing, compacting, grading and trimming the materials and any work incidental thereto.

7-05. Semi-compacted backfill (Item 18). - a. Work included. - The contractor shall place, grade and consolidate materials required for miscellaneous backfill including that behind the west retaining wall of the spillway channel, and at other locations as directed by the contracting officer. The material shall be placed in 12-inch horizontal layers

with only such hand placing as may be necessary to trim to the required slopes. The contractor will not be required to roll the material, but will be required to consolidate it with water to the extent directed so that no settlement or voids will later result. Hand tamping adjacent to the gravel filter at the west retaining wall of the spillway channel will be required.

b. Borrow. - The provisions of 7-04 b shall apply.

c. Measurement and payment. The quantity to be paid for under Item 18 will be the number of cubic yards placed in accordance with the drawings or as directed by the contracting officer. Quantities will be measured in place, after any settlement. The unit contract price shall include payment for placing, grading and trimming the materials, and any work incidental thereto.

7-06. Gravel for roads (Item 19). - a. Work included. - The contractor shall furnish and place gravel of the sizes and quality specified or ordered for the roadway across the top of the dam, and for the base course of the access road, as indicated on the drawings. Gravel for the access road shall not be placed until after installation of all metal culverts, and concrete (see Paragraph 11-08).

b. Material. - The gravel shall be composed of hard, durable stones, together with sand and clay or other approved binding material, and shall be free from thin or elongated pieces. It shall be of such sizes for the bottom course that all will pass a 3-inch screen with square openings and not less than 40 per cent will be retained on a 1/4-inch screen with square openings; and for the top course all will pass through a 3/4-inch screen with square openings, and not less than 35 per cent will be retained on a 1/4-inch screen with square openings; and for either course it shall be uniformly graded. The finer material shall consist of sand and clay or other binding material approved by the contracting officer. Should the material as received for the work fail to maintain suitable proportions of coarse and fine particles, or should the coarse particles not be uniformly graded between the maximum and minimum sizes as specified, it shall be screened or processed in such a manner as to furnish a material to meet the above requirements.

c. Placing. - (1) The gravel shall be placed in two layers, a base course and a top course, each 6 inches thick after compaction. After the subgrade or foundation shall have been properly prepared and compacted and proper drainage provided, the bottom course of gravel shall be spread evenly by means of approved spreader equipment or trucks. The gravel as spread shall be well-graded with no pockets of fine material or segregation of large and fine particles. The gravel, after being spread, shall be compacted until a firm even surface is obtained, by rolling with a self-propelled three-wheel roller weighing not less than ten tons. After the bottom course has been properly and satisfactorily compacted the top course shall be spread and compacted to the required thickness. If at any time the gravel does not contain a sufficient amount of moisture

to insure proper binding of the material, water shall be added by means of a sprinkling wagon, or other approved method, in a sufficient amount to obtain the desired results.

(2) Rolling shall start longitudinally at the side and gradually proceed toward the center of the roadway overlapping on successive trips. During the process of rolling, the gravel shall be dragged; the dragging and rolling shall continue until the gravel does not creep or wave under the roller.

d. Shoulders. - Where indicated on the drawings, shoulders shall be composed of gravel, practically free from loam and clay and with all stones larger than four inches removed. Before the final completion of the work the shoulders shall be reformed, trimmed, raked and rolled.

e. Measurement and payment. - The quantity to be paid for under Item 19 will be the number of cubic yards furnished and placed in accordance with the drawings or as directed. The gravel will be measured in place after compacting. The unit contract price shall include payment for all expenses incidental to furnishing, placing, rolling or otherwise compacting the gravel, and for sand and fine grading of gravel surfaces.

SECTION VIII. ROCK FILL, RIPRAP, AND DRAINS (Items 20 to 25 incl.)

8-01. Definitions. - Rock fill shall include "Dumped Rock in Embankment", Item 20; and "Miscellaneous Rock Fill", Item 21; riprap shall include "Riprap - Hand Placed", Item 22; and "Riprap - Derrick Stones", Item 23; drains shall include "Gravel and Crushed Stone Drains", Item 24; and "Toe Drain", Item 25.

8-02. Rock fill (Items 20 and 21). - a. Work included. - The contractor shall furnish all equipment and labor to construct the rock fill on the slopes and in the toes of the dam embankment except the Toe Drain (Item 25). The rock fill shall be to the limits shown on the drawings, or as ordered. Item 20 includes dumped rock in the embankment, and Item 21 includes miscellaneous dumped rock fill as specified in Paragraph 8-02 b. The miscellaneous rock fill in Item 21 will be required at the head of the intake channel and hillside slopes subject to wash and scour.

b. Material. - Rock fill shall be composed of durable stone of acceptable sizes. Suitable rock, boulders and large cobbles from borrow pits and from the required excavations may be used. The rock fill shall be constructed as shown on the drawings or as directed. Dumped rock fill need not be placed by hand, except to rearrange surface stones to bring the surface to the required lines and grades. The rock shall be placed with the larger rocks at the outer face of the slope. The rock slope shall be brought up in not more than 5-foot lifts, along with the construction of the dam embankment. Dumped rock in embankment, Item 20, shall have no broken stone or gravel small enough to pass a 2-inch ring and at least 50 per cent of the volume shall consist of stones exceeding 1/2 cubic foot in volume. The maximum allowable size of single pieces of rock shall be 1 cubic yard. The boulders and large cobbles used shall contain a sufficient number of large angular stones to give stability to the entire mass. Miscellaneous rock fill, Item 21, shall consist of angular fragments of stone of which none shall be smaller than one cubic foot and of which those exceeding one-half cubic yard shall constitute at least 50 per cent of the volume, except as otherwise authorized by the contracting officer. The material shall be dumped on the gravel blanket and graded off in such a manner as to insure that the larger rocks are uniformly distributed and that the smaller fragments and spalls fill the spaces between the larger ones in such a manner as to produce a reasonably smooth surface with a plus tolerance of 6 inches. Bridging will not be permitted and the full course thickness shall be accomplished at one operation.

c. Measurement and payment. - See Paragraph 8-05 c.

8-03. Riprap (Items 22 and 23). - a. Work included. - (1) The contractor shall furnish all equipment and labor required to construct hand-placed riprap for the conduit intake works and spillway approach included in Item 22.

(2) The contractor shall furnish all materials except the rock for riprap, and all equipment and labor required to construct derrick-stone riprap on the sides and bottom of the conduit outlet works included in Item 23. The contractor shall also furnish grout and grout this riprap.

b. Material and placing. - (1) Hand-placed riprap shall be of durable rock of acceptable sizes. Suitable rock from borrow pits, quarries and from the required excavations shall be used. The riprap shall be laid to the lines and grades shown on the drawings or as directed. A tolerance of 3 inches above or below the slope line shown on the drawings will be allowed for the finished slope surface of the hand-placed riprap. Rock for hand-placed riprap shall be angular and of uniform shape so as to furnish an even, reasonably smooth surface. No individual rock shall be smaller than one-half cubic foot in volume, and at least 75 per cent of the rock used shall be 1 cubic foot in size. At least one-third of the rock, well distributed, shall extend through the entire thickness of the riprap. The rock shall be closely laid on a base of selected pervious fill (see Paragraph 7-02 a) with the greatest dimension normal to the slope, and with joints broken where possible. The joints on the surface of the riprap shall be filled with tightly driven spalls. Large rock shall be well bedded at the edges of the riprap to prevent undermining.

(2) Derrick-placed riprap shall be in accordance with the provisions of sub-paragraph (1) above, except that no individual stone shall be smaller than one-half cubic yard in volume, and at least 50 per cent of the stone shall be 1 cubic yard in size.

(3) Grouting shall be done on clean riprap surface with a grout mixture composed of 1 part Portland cement and 2-1/2 parts sand by volume (considering 1 bag of cement as 1 cubic foot), combined with water to a suitable consistency. The grout shall be worked into the joints of the riprap surface with brooms or other means so as to completely fill the voids.

c. Measurement and payment. - The quantity to be paid for under Items 22 and 23 will be the number of cubic yards of riprap satisfactorily placed in the completed work to the specified or ordered lines and grades. The unit contract prices shall include payment for placing, furnishing the grout, and grouting the riprap.

8-04. Gravel and crushed stone drains (Item 24). - a. Work included. - The contractor shall construct gravel and crushed stone drains as indicated on the drawings, or as otherwise required by the contracting officer.

b. Description. - (1) The trenches and other excavations for the drains shall be to the dimensions and in the locations shown on the drawings, except as otherwise directed by the contracting officer. The gravel backfilling used shall be graded so that not more than 5 per cent by weight passes a 1/4-inch standard mesh screen and not more than 5 per cent by weight is retained on a 2-inch standard mesh screen. The crushed stone backfilling used shall consist of angular fragments of uniform

quality throughout, free from thin or elongated pieces, soft or disintegrated stone, dirt or other objectionable matter. It shall be graded so that no stone will be retained on a standard No. 2 mesh sieve with openings of 1-1/4 inches and not more than 15 per cent by weight shall pass a 3/4-inch mesh sieve.

(2) The drains shall be protected from concrete intermixture by the use of wood, cloth, or other suitable material. Drains under the outlet portal shall be protected by a layer of asphalt-saturated felt, conforming to "Federal Specification HH-F-191, Type II", 36 inches wide. The felt shall extend beyond the trench a minimum of 9 inches on each side. Black steel relief pipes, 2-1/2 inches inside diameter, shall extend from the gravel drains through the protective felt and concrete floor slab or sidewalls and brought flush to the finished concrete surfaces as indicated on the drawings.

c. Measurement and payment. - The quantity measured for payment under Item 24 will be the number of linear feet of completed drains actually constructed where ordered. The unit contract price for Item 24 shall include furnishing all material and labor incidental to the construction of the drains required or ordered, except the relief pipes which are included in Item 45.

8-05. Toe drain (rock fill) (Item 25). - a. Work included. - The contractor shall furnish all equipment and labor required to construct the toe drains in the locations and to the dimensions shown on the drawings. The toe drains are rock-filled trenches, previously excavated below the natural ground surface, draining the downstream toe of the embankment to the river.

b. Material. - The rock fill shall be composed of durable rock of acceptable sizes. Suitable rock, boulders and large cobbles from borrow pits and from the required excavations may be used. The range in acceptable sizes shall be similar to that specified for dumped rock in embankment (see Paragraph 8-02 b.). The rock fill shall be dumped in place. The face rock of the toe drains shall be so placed as to insure a reasonable smooth and continuous surface. The toe drains shall be constructed so that the longitudinal slope will be towards the stream channel or other natural drain to facilitate free drainage of the embankment.

c. Measurement and payment. - The quantities to be paid for under Items 20, 21 and 25 will be the number of cubic yards of rock fill satisfactorily placed to the specified lines or grades in the completed work. The unit contract prices shall include payment for placing and trimming the rock fill.

SECTION IX. DRILLING AND GROUTING (Items 26 to 28 incl.)

9-01. Drilling Holes in Rock or Concrete (Items 26 and 27). - a. Work included. - The contractor shall drill holes in rock or concrete for grouting, for inspection of grouting, or for other purposes wherever ordered. Holes shall be of such diameter as may be necessary to attain the depths ordered or to permit the setting of grout pipes, weepers or other pipes and anchors.

b. Description. - (1) Grout holes shall be 2-inch holes and shall be drilled through a 2-1/2 inch black steel pipe set in the concrete as shown in detail on the drawings, or shall be drilled through concrete or rock direct, except that the holes under the spillway weir shall be drilled and the horizontal holes in the gate shaft may be drilled prior to placing of concrete if, in the opinion of the contracting officer, such procedure is justified. Test holes for inspection shall be drilled as directed by the contracting officer. Weep holes shall be drilled as indicated on the drawings or as ordered. After the holes are drilled they shall be either grouted or kept capped until the grouting operation.

(2) Two-inch holes for steel anchors shall be drilled to the depth shown on the drawings or as directed by the contracting officer. The holes shall be thoroughly cleaned by flushing out with air and water under pressure and excess water removed. The holes shall be tightly plugged until ready to place and grout the anchor rods. (see Paragraph 10-18 c (2) d).

(3) Location of grout holes shown on the drawings may be changed by the contracting officer in accordance with the conditions determined after the rock is exposed by the construction operations. Items 26 and 27 shall not include holes which are not over 1-1/4 inches in diameter and not over 6 inches in depth, for small anchor or expansion bolts.

c. Measurement and payment. - The quantity to be paid for under Items 26 and 27 will be the number of linear foot of grout hole drilled. The unit contract prices shall include payment for all expenses incidental to drilling the grout holes. Payment for core or rotary drilling will be made under Item 26; payment for ordinary drilling of holes approximately 2 inches in diameter by hammer drills will be made under Item 27.

9-02. Pressure Grouting (Item 28). - a. Work included. - The contractor shall furnish all materials for grout, except cement, and shall mix and place grout of Portland cement with sand or without sand, in the proportions directed. The amount and extent of grouting required cannot be fully determined in advance of construction. The holes drilled under the spillway weir shall be grouted before any concrete for the weir is placed.

b. Mixing and placing grout. - (1) The apparatus for mixing and placing the grout shall be subject to approval by the contracting

officer before use. It shall be capable of placing grout under pressure up to 100 pounds per square inch. All grout shall be pumped with a duplex piston-type pump. UngROUTED holes are to be left open to facilitate the escape of air and water, but if during the grouting operation the grout is found to flow from an adjacent open hole or holes in amounts that will interfere seriously with the grouting operations, the open hole shall be capped temporarily. Grouting operations shall be continuous for any hole and any holes lost through negligence of the contractor or equipment failure shall be re-drilled and grouted at the contractor's expense. After the grouting at the connection is completed, the pressure at that connection shall be maintained until the grout has set sufficiently to remain in place.

(2) Prior to the beginning of grouting operations each hole shall be cleaned of mud and dirt by applying air and water under pressure. A water pressure test not to exceed 50 pounds per square inch shall be put on each hole to determine the probable behavior of the hole when being grouted. Alternate holes shall be grouted in order, depending upon their relative location on the work, from upstream to downstream, and from the lower elevations to the higher elevations. The grout shall be a neat cement mixture with varying water cement ratios. As directed by the contracting officer, addition of clean mortar sand may be made to the grout mixture. Grouting operations at a hole shall be started with a thin grout mixture having a water cement ratio not exceeding six by volume (six parts of water to one of cement). As the grouting operation proceeds, the water cement ratio of the grout mixture shall be gradually decreased, until the water cement ratio of the grout mixture becomes one by volume (equal parts of water and cement).

(3) The use of some device to permit grouting at different elevations in the grout holes will be required if, in the opinion of the contracting officer, it is necessary.

c. Measurement and payment. - In measuring the grout for payment one cubic foot of grout will be allowed for each sack of cement used for neat cement grout. Where sand is added to the grout mixture, one cubic foot will be allowed for each cubic foot of loose dry sand used. The quantity to be paid for under Item 28 will be the number of cubic feet of grout, mixed in accordance with directions, and forced into the grout holes. If in the opinion of the contracting officer there is avoidable waste of grout, the volume of grout unnecessarily wasted, as estimated by him, will be deducted from the quantity to be paid for. Payment will be made at the unit contract price except for cement, which will be paid for under Item 29. Payment for black steel grout pipes will be made at the unit contract price for Item 45.

SECTION X CONCRETE (Items 29 to 37 incl.)

COMPOSITION, CLASSIFICATION, AND STRENGTH.

10-01. Composition. - Concrete shall be composed of cement, fine aggregate, coarse aggregate and water so proportioned and mixed as to produce a plastic, workable mixture in accordance with all requirements under this section and suitable to the specific conditions of placement.

10-02. Classification. - Except where required to meet special conditions all concrete shall be either Class "A" or Class "B", as designated in SECTION XI and on the drawings for the various parts of the work in accordance with the conditions of application and the proportions of materials and strengths required.

10-03. Strength. - The mixes will be designed to secure concrete having the following compressive strengths at the age of 28 days, as determined by breaking standard 6-inch diameter by 12-inch height or 8-inch diameter by 16-inch height test specimens:

<u>Class</u>	<u>Average for any 25 consecutive cylinders</u>	<u>Minimum for any one cylinder</u>
A	3,400 lbs. per sq. in.	2,600 lbs. per sq. in.
B	3,000 lbs. per sq. in.	2,200 lbs. per sq. in.

10-04. High-early-strength concrete. - High-early-strength concrete made with high-early-strength Portland cement or other special cements shall be used only when specifically authorized by the contracting officer. The 7-day compressive strength of concrete of any class, when made with high-early-strength cement, shall be at least equal to the specified minimum 28-day compressive strength for that class. All provisions of these specifications, except for cement, shall be applicable to such concrete. Any high-early-strength cement used shall be approved by the contracting officer before use.

MATERIALS.

10-05. Portland cement. (Item 29) - a. The contractor shall furnish Portland cement of the quality herein specified in sufficient quantity for the work required. Cement for all concrete, grout and mortar, except as specified in subparagraph b, shall conform to Federal Specification SS-C-206, for "Cement, Portland, Moderate-Heat-of-Hardening", except that Paragraph E-7, "Heat of Hydration", shall be considered inoperative.

b. High-early-strength Portland Cement. - Cement for high-early-strength concrete shall be in accordance with Federal Specifications SS-C-201 "Cement, Portland, High-Early-Strength".

c. Special test requirements. - Cement will be tested by the Government at the Central Concrete Laboratory, West Point, N. Y. No cement shall be used until notice has been given by the contracting officer that the test results are satisfactory. Cement which has been stored, other

than in the bins at the mills, for more than 4 months after being tested shall be retested before use. Ordinarily, no cement shall be used until after it has satisfactorily passed both the 7 and 28-day tests, but in cases of emergency the contracting officer may waive the 28-day tests and permit the use of cement which has satisfactorily passed the soundness and 7-day tests; provided it is the product of a quarry and mill having established a reputation of not less than 3 years' standing, for the production of high-grade cement. If the tests prove any cement unsatisfactory which has been delivered at the site of the work, such cement shall be promptly removed from the work and its vicinity.

d. Identification. - Cement shipped in bags shall be identified by marking or tagging the bags with the identifying number or symbol of the Federal Specifications under which it was manufactured. Bulk shipments of cement shall be likewise identified by a suitable device affixed to each car or other type of bulk carrier. Marking or tagging shall be done at the mill.

10-06. Fine aggregate. - a. Composition. - Fine aggregate shall be natural sand.

b. Quality. - Fine aggregate shall consist of hard, strong, durable and uncoated particles.

c. Grading. - (1) Except as provided in (2) below fine aggregate shall conform to the following requirements:

<u>Total passing</u>	<u>Per cent by weight</u>
No. 4 sieve	95-100
No. 16 sieve	35-75
No. 50 sieve	10-25
No. 100 sieve	1.5 to 7

(2) Deficiencies in the percentages of fine aggregate passing the No. 50 and No. 100 sieves, as required in the above gradation, may be remedied by the addition of pozzuolanic or cementitious materials, excepting Portland cement; provided, at least 5 per cent passes the No. 50 sieve and the aggregate is of proper consistent gradation within the specified limits. Such added material, which will be considered and included as fine aggregate, shall conform to the requirements in Paragraph 10-08 and shall be in sufficient quantity to meet the minimum requirements above for percentage passing the No. 100 sieve and otherwise to produce the workability required by the contracting officer. The quantity and characteristics of any material used for the purpose of correcting workability shall be such that when the concrete is gaged to the proper consistency the total water content shall not exceed by more than 1 gallon per cubic yard the minimum quantity required for proper consistency when not using the admixture. The blending of any material with the original naturally graded sand to remedy deficiency in gradation shall be accomplished in charging the mixer, unless otherwise specifically authorized by the contracting officer.

d. Detrimental substances. - The substances designated shall not be present in excess of the following amounts:

	<u>Per cent by weight</u>
Mica	0.5
Clay lumps	1.0
Material removed by decantation from aggregates not more than	3.0
Shale	0.5

e. Mortar strength. - Mortar specimens made with the fine aggregate shall have a compressive strength at 28 days of at least 90 per cent of the strength of similar specimens made with Ottawa sand having a fineness modulus of  $2.40 \pm 0.10$  and the same cement.

f. Tests. - Fine aggregate shall be subject to careful, thorough analyses, including magnesium sulphate soundness tests (see Paragraph 10-07 d), to determine conformity with all requirements of these specifications.

10-07. Coarse aggregate. - a. Composition. - Coarse aggregate shall be washed gravel or crushed stone.

b. Quality. - Coarse aggregate shall consist of hard, tough and durable particles free from adherent coating. It shall contain no vegetable matter nor soft, friable, thin or elongated particles in quantities considered deleterious by the contracting officer. The substances designated shall not be present in excess of the following amounts (by weight):

Soft fragments	5 per cent
Clay lumps	$1/4$ per cent
Removed by decantation	1 per cent

When the material removed by decantation consists essentially of crusher dirt the maximum amount permitted may be raised to  $1-1/2$  per cent. Aggregate which has disintegrated or weathered badly under exposure conditions similar to those which will be encountered by the work under consideration, shall not be used. When crushed stone is used the crusher shall be equipped with a screening system which will entirely separate the dust from the stone and convey it to a separate bin except when washed.

c. Size. - (1) Coarse aggregate shall be well graded from fine to coarse so that concrete of the required workability, density, and strength can be made without the use of an excess amount of sand, water or cement.

For Class "A" concrete, required for Items 30, 33 and 36, the maximum size mesh screen for the aggregate shall be not less than  $3/4$  inch nor more than 1 inch; required for Items 31 and 34, the maximum size mesh screen shall be not less than 1 inch nor more than 2 inches.

For Class "B" concrete, required for Item 35, the maximum size mesh screen for the aggregate shall be not less than 2 inches nor more than 4 inches, unless otherwise specified. For Item 32 the mesh screen for the aggregate shall not be less than 1 inch nor more than 2 inches unless otherwise specified.

(2) When the maximum size mesh screen is greater than 1 inch, the aggregate shall be separated, and the specified size delivered separately to individual proportioning hoppers, in accordance with the following:

For maximum size mesh screen, 1 inch to 2 inches, inclusive:

1. No. 4 to 1/2 maximum size mesh screen, inclusive.
2. Over 1/2 maximum size to and including full maximum size mesh screen.

For maximum size mesh screen greater than 2 inches:

1. No. 4 to 1 inch maximum size mesh screen, inclusive.
2. Over 1 inch maximum size to and including 1/2 maximum size mesh screen.
3. Over 1/2 maximum size to and including full maximum size mesh screen.

Within any of the above-indicated size limits, not less than 85 per cent of the material shall be retained on a standard square mesh screen of the minimum size indicated and not more than 5 per cent shall be retained on a standard square mesh screen of the maximum size indicated.

(3) The grading of the coarse aggregate, in the mixed concrete, shall fall within the following limits:

	(Per cent by weight) <u>Passing</u>
Maximum size mesh screen (square mesh)	97-100
1/2 maximum size mesh screen (square mesh)	40-70
No. 4 sieve	0-6

d. Tests. - Coarse aggregate will be subjected to freezing and thawing tests and to careful, thorough analyses to determine conformity with all requirements of these specifications. Coarse aggregate will be subjected to 10 cycles of the magnesium sulphate test for soundness. No aggregate shall be used which develops a loss in excess of 10 per cent by weight.

10-08. Material added for workability. - a. The use of any material added to the mix to improve workability (see Paragraph 10-06 c (2)), which, in the opinion of the contracting officer, may have an injurious

effect on the strength, density, and durability of the concrete, will not be permitted. Before approval of any material, the contractor will be required to submit the results of complete chemical and sieve analyses made by an acceptable testing laboratory. Subsequent tests will be made of samples taken by the contracting officer from the supply of the material being used on the work to determine whether it is uniform in quality with that approved.

b. The material added shall be pozzuolanic, cementitious or silicious. It shall not contain effective early-heat-producing elements nor compounds, such as those contained in Portland cement, nor shall its use result in a material increase in the free-line content of the concrete. It shall also be in conformity with the following requirements:

Free moisture - a total of not more than 3 per cent by weight.

Passing #30 sieve - not less than 100 per cent by weight.

Passing #200 sieve - not less than 80 per cent by weight.

10-09. Water. - The water used in mixing concrete shall be fresh, clean, and free from injurious amounts of oil, acid, alkali or organic matter.

10-10. Storage. - a. Cement. Immediately upon receipt at the site of the work, cement shall be stored in a thoroughly dry, weather-tight, and properly ventilated building with adequate provisions for the prevention of the absorption of moisture. The building shall be of adequate capacity to provide for the requirements of delivery and construction schedules. Storage shall be such as to permit easy access for inspection and definite identification of each shipment.

b. Aggregates. The fine and coarse aggregates shall be stored separately (see Paragraph 10-07 c (2)) and in such manner as to avoid the inclusion of any foreign material in the concrete. Stockpiles of coarse aggregates shall be built in horizontal layers to avoid segregation.

10-11. Sampling and Testing Aggregates. - Except where provided otherwise by these specifications, all sampling and testing of aggregates shall be made in accordance with the Federal Specifications. Unless specified otherwise, all test samples shall be taken under the supervision of the contracting officer and supplied to the Central Concrete Laboratory, West Point, N. Y., by the contractor at his expense. The source from which concrete aggregates are to be obtained shall be selected by the contractor well in advance of the time when they will be required in the work, and suitable samples as they are to be used in the concrete shall be furnished to the contracting officer at least 30 days in advance of the time when the placing of the concrete is expected to begin. It is expected that the contractor will obtain fine and coarse aggregates from approved commercial sources.

## PROPORTIONING, MIXING, AND PLACING

10-12. Proportioning. - a. Basis. - All concrete materials will be proportioned so as to produce a workable mixture in which the water content will not exceed the maximum specified.

b. Control. - The exact proportions of all materials entering the concrete shall be as directed by the contracting officer. The contractor shall provide all equipment necessary to positively determine and control the actual amounts of all materials entering into the concrete. The proportions will be changed whenever in the opinion of the contracting officer such change becomes necessary to obtain the specified strength and the desired density, uniformity and workability, and the contractor will not be compensated because of such changes.

c. Measurement. - All materials shall be measured by weight except that water may be measured by volume when so authorized by the contracting officer. One bag of cement will be considered as 94 pounds in weight and 1 gallon of water as 8.33 pounds.

d. Cement Content. - Each cubic yard of concrete shall contain not less than the quantity of cement stated below:

Class "A" - 5.5 bags or 517 pounds.

Class "B" - 4.5 bags or 423 pounds.

For concrete deposited in water the minimum cement content shall be 6.5 bags or 611 pounds to each cubic yard of concrete in place.

e. Water content. - (1) In calculating the total water content in any mix the amount of moisture carried on the surface of the aggregate particles shall be included. The total water content for a bag of cement for each batch of concrete shall not exceed the following:

Class "A" - 5.5 gallons or 45.8 pounds.

Class "B" - 6.5 gallons or 54.1 pounds.

In all cases, however, the amount of water to be used shall be the minimum amount necessary to produce a plastic mixture of the strength specified and of the desired density, uniformity and workability. In general, the consistency of any mix shall be that required for the specific placing conditions and methods of placement, and ordinarily the slump shall be between 1 inch and 3 inches when tested in accordance with "The Tentative Method of Test for Consistency of Portland Cement Concrete", (A.S.T.M. Designation D 138-32T), of the American Society for Testing Materials.

(2) An increase in the maximum water content, based only on the requirements of materials added in accordance with Paragraph 10-06 c to improve workability will not be permitted unless comparative tests under job conditions show conclusively that such increase in water

content will not result in a decrease in concrete strength and provided further that such increase does not exceed 1 gallon per cubic yard.

f. Aggregate content. - The total volume of aggregates to be used in each cubic yard of concrete shall be that necessary to produce a dense mixture of the required workability as determined by the contracting officer.

10-13. Mixing and placing. - a. Equipment. - Concrete shall be mixed in approved mechanical mixers of a rotating drum type, except that if permitted relatively small quantities may be mixed by hand in a satisfactory manner. Concrete shall be mixed at all times by competent and experienced men. The contractor shall provide at the site of the work a modern and dependable batch type mixing plant with a minimum capacity of 150 cubic yards of concrete per 8 hours. The plant shall include not fewer than two complete mixers with separate power plants, having a minimum capacity of  $3/4$  cubic yard each. The equipment shall provide adequate facilities for the accurate measurement and control of each of the materials entering the concrete. The complete plant assembly, including provisions to facilitate the inspection of all operations at all times and the adequacy and dependability of each of its parts shall be subject to the approval of the contracting officer and shall conform to the following requirements:

(1) It shall be capable of ready adjustment for compensating for the varying moisture content of the aggregates and for changing the proportionate batch weights.

(2) It shall be capable of controlling the delivery of all material within 1 per cent by weight of the specified amounts.

(3) It shall be arranged to permit the convenient removal of the material in excess of the specified tolerances.

(4) It shall include a visible dial or any suitable device which will accurately register the scale load at any stage of the weighing operations from zero to full capacity.

(5) The accuracy of the weighing equipment shall conform to the requirements of the U. S. Bureau of Standards and shall be tested monthly or otherwise when required at the expense of the contractor.

(6) It shall include a device for accurately measuring and indicating the quantity of water entering the concrete, and the operating mechanisms must be such that no leakage will occur when the valves are closed.

(7) It shall include a device for accurately and automatically measuring and indicating the time required for mixing, which may be interlocked to prevent the discharge of concrete from the mixer before the end of the mixing period.

(8) It shall include a device for properly recording and indicating the number of batches handled.

b. Time. - The minimum time for mixing each batch, after all materials are in the mixer, shall be as follows:

3/4 to 1-1/2 cu. yd. mixer	1-1/2 minutes
Larger than 1-1/2 cu. yd. mixer	2 minutes

The mixer shall revolve a minimum of 12 revolutions after all materials have been placed in it and at a uniform speed. Neither speed nor volume capacity of the mixer shall exceed those recommended by the manufacturer. Excessive overmixing, requiring additions of water to preserve the required consistency, will not be permitted.

c. Conveying. - Concrete shall be conveyed from mixer to forms as rapidly as practicable, by methods which will prevent segregation or loss of ingredients. It shall be deposited as nearly as practicable in its final position. Conveying of concrete by means of chutes will not be permitted except for short chutes in the forms to distribute the concrete. Chutes used shall be such that the concrete slides in them and does not flow. Chutes with a flatter slope than 1 on 2 will not be permitted. There shall be no free vertical drop greater than 5 feet except where specifically authorized by the contracting officer.

d. Placing. - (1) Concrete shall be placed before initial set has occurred, and in no event after it has contained its water content for more than 45 minutes.

(2) Unless otherwise specified, all concrete shall be placed in the dry upon clean, damp surfaces, free from ice, frost or running water, and never upon soft mud, dry porous earth, or upon fills that have not been subjected to approved rolling, puddling or tamping so that ultimate settlement has occurred.

(3) Rock surfaces upon which concrete is placed shall be approximately horizontal or stepped, rough, and free from loose material or other matter interfering with a satisfactory bond. The rock shall be washed, scrubbed with steel brushes or brooms, and spread with a layer of mortar about 1/2 inch thick, immediately before the concrete is placed. The mortar shall be of the same cement-sand ratio as used in the concrete.

(4) Unless otherwise specifically authorized or directed, concrete in mass structures shall be placed in monoliths not exceeding 40 feet in length or width. The layout of all monoliths shall be as directed or approved by the contracting officer before concreting is commenced.

(5) All concrete shall be deposited in approximately horizontal layers not to exceed 24 inches in thickness unless otherwise

specifically authorized or directed by the contracting officer and the concreting shall be carried on as a continuous operation, as far as practicable, until the placing in the course, section, panel or monolith is completed. Courses shall generally have a minimum thickness of 4 feet, and a maximum of 18 feet, except that in hot weather the contracting officer may direct that the maximum be reduced to 8 feet. A minimum time interval of 48 hours shall be allowed between successive courses for the dissipation of heat of hydration. In walls of buildings, courses including door or window openings shall terminate at the tops of the openings.

(6) Concrete shall be placed with the aid of mechanical vibrating equipment as approved by the contracting officer. Vibration shall be transmitted directly to the concrete, and in no case shall it be transmitted through the forms. The frequency of vibration shall be not less than 5,000 per minute. The intensity of vibration shall be sufficient to cause flow or settlement of the concrete into place. The vibration shall be of sufficient duration to accomplish thorough compaction as approved by the contracting officer. Vibration shall be supplemented by forking or spading by hand adjacent to the forms on exposed faces in order to secure smooth, dense, even surfaces. The concrete shall be compacted and worked in an approved manner into all corners and angles of the forms and around reinforcement and embedded fixtures.

(7) In dropping concrete through reinforcement, care shall be taken that no segregation of the coarse aggregate occurs. On flat surfaces, where the congestion of steel near the forms makes placing difficult, a mortar of the same cement-sand ratio as is used in the concrete shall be first deposited to cover the form.

(8) All top surfaces not covered by forms and which are not to be covered by additional concrete or backfill shall be carried slightly above grade and struck off by board finish (see Paragraph 10-15), except that top surfaces of walls and piers not covered by forms and which are not to be covered by additional concrete or backfill when poured in excess of 10 feet in height in one pour shall be carried not less than 2 inches above the specified finished elevation and struck off by board screed.

e. Construction joints. - Vertical joints shall be formed with tongue-and-groove bonds or keys at such locations and of such shapes and dimensions as approved or directed by the contracting officer. Horizontal joints shall be formed with keys, or, where horizontal pressure is always in one direction, with stops. Where required, dowel rods shall be used. All concrete in vertical members shall have been in place not less than 12 hours, and longer if so directed by the contracting officer, before concrete in horizontal members resting thereon is placed. As soon as practicable after placing and immediately before placing the succeeding layers is resumed, all approximately horizontal surfaces shall be

washed with a high pressure air-and-water jet. Wet sand blasting may be done when required to remove alkali, algae, stains, and other substances injurious to the bond. The time and method of using the air and water jet or the wet sand blasting shall be such that all laitance, scum, etc., will be removed so that partly embedded aggregate is not disturbed and is washed clean. After final cleaning and immediately before placing is resumed, the surfaces shall be wetted and spread with a layer of mortar 1/2-inch thick, thoroughly brushed in. The mortar shall be the same cement-sand ratio as the concrete. Where specified or otherwise required by the contracting officer for watertight construction, copper strips not less than 18 inches in width and weighing not less than 20 ounces per square foot, properly crimped or bent, shall be placed in the concrete to span the joint. (see Paragraph 16-09).

f. In water. - When specifically authorized, concrete may be deposited in water having a temperature above 45 degrees F. The methods and equipment used shall be subject to the approval of the contracting officer. When deposited by the tremie method, the tremie shall be water-tight and sufficiently large to permit a free flow of concrete. The discharge end shall be kept continuously submerged in the concrete and the shaft kept full of concrete to a point well above the water surface. When the bottom-dump-bucket method is used, the bucket shall not be dumped until after it has come to rest on the surface upon which the concrete is to be deposited. The bucket shall be provided with a suitable cover, and the bottom doors, when tripped, shall open freely. The bucket shall be completely filled and slowly lowered in order to avoid backwash, and when tripped it shall be slowly withdrawn until entirely free of the concrete. With either method, concreting shall proceed without interruption until the top of the concrete is well above the water surface.

g. Cold weather. Concrete shall not be placed when the ambient atmospheric temperature is below 35 degrees F., nor when the concrete is likely to be subjected to freezing temperatures before final set has occurred, unless specifically authorized by the contracting officer in writing. When so authorized, the materials shall be heated in order that the temperature of the concrete, when deposited, shall be not less than 50 degrees F. nor more than 100 degrees F. All methods and equipment for heating shall be subject to the approval of the contracting officer.

h. Hot weather. - For concrete placed during the extremely warm summer months and otherwise, when directed by the contracting officer, the aggregates shall be cooled by frequent spraying in such manner as to utilize the cooling effect of evaporation. During such periods the placement schedule shall be arranged as approved by the contracting officer in such manner as to provide time for the temperature of the previously placed course to begin to recede. The mixing water shall be the coolest available at the site insofar as is practicable.

10-14. Test specimens. - a. Number. - Test specimens, to determine whether the compressive strength of the concrete is in accordance with

that specified in Paragraph 10-03, will be taken by the inspector. At least 1 set of 3 specimens will be made for every major pour and in general for every 500 cubic yards of concrete placed, but in any event, a sufficient number of specimens will be taken to give a comprehensive knowledge of the concrete in each section of the work.

b. Method. - All specimens will be taken from the concrete at the mixing plant. The specimens will be tested by the Government at the Central Concrete Laboratory, West Point, New York. All costs of transportation and testing of specimens will be borne by the Government.

10-15. Finishing. - a. Immediately after placement, the concrete shall be properly forked back along the faces of all forms by the use of standard concrete forks or spades unless otherwise specifically authorized or directed by the contracting officer. The finished surfaces shall be free from sand streaks or other voids and the plastering over of such surfaces will not be permitted. Defective concrete shall be repaired by cutting out the unsatisfactory material, in no case less than 2 inches deep, and placing new concrete which shall be formed with keys, dovetails or anchors to attach it securely to the other work. One anchor shall be placed for each 64 square inches of area and the sides of the cut areas shall be generally rectangular. This concrete shall be drier than the usual mixture and shall be thoroughly tamped into place behind forms securely fastened. Unless otherwise specified, all surfaces of concrete, not covered by forms, that are not to be covered by additional concrete or backfill, shall have a wood float finish without additional mortar, and shall be true to elevations as shown on the drawings. Care shall be taken to see that all excess water is removed before making this finish. Other surfaces shall be brought to the specified finished elevation and left true and regular as approved by the contracting officer. Where considered necessary by the contracting officer, or where indicated on the drawings, joints shall be carefully made with a jointing tool. Every precaution shall be taken by the contractor to protect finished surfaces from stains or abrasions. No fire shall be permitted in direct contact with any concrete at any time. Concrete surfaces, or edges likely to be injured during the construction period, shall be properly protected by leaving the forms in place, or by erecting covers satisfactory to the contracting officer.

b. Floor surface. - (1) Surface finish at operating floor, elevation 565.5. - The top of the intake structure, forming the floor of the operating house superstructure, shall be finished with a 2-inch monolithic sand-cement mortar surface.

(2) Materials and mixing. - The mortar shall be of one part Portland cement and two parts approved clean, coarse, sand. The cement and sand shall be thoroughly mixed dry and then sufficient water shall be added to produce a medium stiff mortar.

(3) Placing. - All water, laitance and any foreign matter shall be removed from the surfaces. The mortar shall be spread evenly over the base within 45 minutes after the base has been placed. After placing, the mortar shall be floated to a true, regular surface with a wood float. Trowelling shall be the minimum amount consistent with obtaining a smooth dense surface and shall not be done until the mortar has hardened sufficiently to prevent excess fine material from being worked to the surface. The floor surfaces shall be marked in 6-foot squares by means of an expansion joint tool or other suitable means, making grooves about 1/4-inch wide and deep.

(4) Protection and curing. - The contractor shall protect the floor finish from the elements and from damage due to building operations or other causes. As soon as the mortar has hardened sufficiently to prevent damage, the floor finish shall be completely covered with sand or sawdust which shall be kept damp for a period of two weeks. After the curing has been accomplished, the covering and all foreign material shall be removed and disposed of in a manner satisfactory to the contracting officer.

(5) Payment. - No separate payment will be made for the monolithic floor finish but the volume thereof will be included in the volume estimated and paid for under Item 33.

c. Retaining walls. Exposed surfaces shall be free from all unsound patches, paste, lather, powder, and objectionable marks. Any surface which has been disfigured by drippings from the placing or finishing of parts above shall be cleaned, using a weak solution of muriatic acid, if necessary, all of which shall be executed to the satisfaction of the contracting officer.

10-16. Curing. - a. Warm weather. - All concrete shall be adequately protected from injurious action by the sun. Fresh concrete shall be protected from heavy rains, flowing water, and mechanical injury. All concrete shall be kept wet for a period of not less than 14 days by covering with water, or with an approved water-saturated covering, or by a system of perforated pipes or mechanical sprinklers, or any other approved method which will keep all surfaces continuously (not periodically) wet. Where wood forms are left in place for curing, they shall be kept wet at all times to prevent opening at the joints and drying out of the concrete. Water for curing shall be generally clean and entirely free from any elements which in the opinion of the contracting officer might cause staining or discoloration of the concrete.

b. Cold weather. - Concrete when placed during cold weather shall be kept moist and provided with adequate protection for a period of not less than 14 days, subject to the approval of the contracting officer, so that the air in contact with the concrete will be maintained at temperatures between 50 degrees F. and 70 degrees F. for at least the first 5 days of the curing period. For massive sections, where the atmospheric temperatures are sufficiently low in the opinion of the contracting officer to cause excessively rapid cooling and contraction of the exterior surfaces, this period for maintaining the temperature of the air in contact with the concrete between 50 and 70 degrees F. shall extend over the entire curing period. Salt or other chemicals shall not be admitted into the mixture to prevent freezing except with the approval of the contracting officer.

#### FORMS, REINFORCEMENT, AND PAYMENT.

10-17. Forms. - a. Materials. - Forms shall be of wood, steel or other approved material, except that where lining is not specified, the sheeting for all exposed surfaces shall be tongue-and-groove lumber of uniform width unless otherwise specifically authorized. Forms of like character shall be used for similarly exposed surfaces in order to produce a uniform appearance. The type, size, shape, quality and strength of all materials of which the forms are made shall be subject to the approval of the contracting officer.

b. Construction. - Forms shall be built true to line and grade, and shall be mortar-tight and sufficiently rigid to prevent displacement or sagging between supports. Responsibility for their adequacy shall rest with the contractor. Their surfaces shall be smooth.

and free from irregularities, dents, sags, or holes when used for permanently exposed faces. Bolts and rods used for internal ties shall be so arranged that, when the forms are removed, all metal will not be less than 2 inches from any concrete surface. Wire ties will not be permitted where the concrete surface will be exposed to weathering and discoloration will be objectionable. All forms shall be so constructed that they can be removed without hammering or prying against the concrete. Unless otherwise indicated, suitable moldings shall be placed to bevel or round exposed edges, at expansion joints or any other points as may be required by the contracting officer.

c. Coating. - Forms for exposed surfaces shall be coated with a non-staining mineral oil which shall be applied shortly before the concrete is placed. Forms for unexposed surfaces may be thoroughly wetted in lieu of oiling, immediately before the placing of concrete, except that in freezing weather oil shall be used.

d. Removal. - Forms shall not be removed without the approval of the contracting officer, and all removal shall be accomplished in such manner as will prevent injury to the concrete. Forms shall not be removed before the expiration of the minimum number of days indicated below, except when authorized in writing by the contracting officer. When, in the opinion of the contracting officer, conditions on the work are such as to justify it, forms may be required to remain in place for longer periods.

Arches, beams and slabs	14 days
Columns	7 days
Walls and vertical faces	2 days
Tunnel lining	2 days

e. Form lining. - In addition to the requirements for work specified above, wood forms for walls of the operating house which will be visible in the finished structure, or for water passages in the intake structure and at other locations indicated on the drawings or as directed by the contracting officer, shall be lined with sheet steel or with pressed wood sheets similar to Masonite or approved equal. Lining shall be applied directly to the sheeting. Forms for window and door jambs and their flat or arched soffits shall be lined and the corner intersections chamfered. The jointing of the lining shall be neat and close and no patch pieces, plugs, cleats or blocking will be permitted. Over-run of lining shall be trimmed to secure proper fit to adjoining surfaces. Lining with bruises, imprints or hammer marks shall not be used.

10-18. Furnishing, bonding, and placing steel reinforcement (Item 37). - a. Work included. - (1) The contractor shall furnish, cut, bend and build into the concrete, in accordance with the drawings and directions, all reinforcing steel of deformed bars, dowels or anchors, steel plates for water stops across contraction joints, if any, or any other plain steel for similar purposes.

(2) Steel reinforcement may be cut and bent at the mill or in the field. All bending shall be in accordance with standard approved practice and by approved machine methods.

b. Materials. - Reinforcing steel shall be of new billet, intermediate grade, open-hearth steel, deformed, and shall conform to the Federal Specifications QQ-B-71a for "Bars, reinforcement, concrete, Type "B", Grade 2 dated January 12, 1938". If available, certified copies of any mill test shall be furnished by the contractor and the steel shall be subjected to such tests as the contracting officer may consider necessary to establish its quality, including particularly the requirements of bending and elongation. The steel shall be free from oil, paint, dirt or excessive rust.

c. Placing. - (1) All steel reinforcement shall be placed in the exact positions and with the spacing shown on the drawings or ordered, and it shall be so fastened in position as to prevent its becoming displaced during the placing of the concrete. The clear distance between parallel rods shall be not less than one and one-half times the diameter of round rods, or twice the side dimensions of square rods, and unless specifically authorized, shall in no case be less than 1 inch.

(2) Except where otherwise indicated, reinforcement shall be placed as follows:

(a) All main reinforcement shall be placed not less than 4 inches from any surface, except in slabs and in buildings.

(b) All main reinforcement in walls, in slabs or buildings exposed to the weather and in fire resistant construction, shall be placed not less than 1 inch from the surface in walls and slabs, 1-1/2 inches in floor beams and 2 inches in girders and columns. The covering of stirrups, spacer rods and similar secondary reinforcement may be reduced by the diameter of such rods. The above dimensions shall be measured from the face of the reinforcement to the face of the forms.

(c) Where splices in reinforcement, in addition to those indicated are necessary, there shall be sufficient lap to transfer the stress by bond as may be directed. Rods shall be lapped not less than 40 diameters and splices shall be staggered. The lapped ends of rods shall be separated sufficiently or connected properly to develop the full strength of rod. Adjacent sheets of mesh reinforcement shall be spliced by lapping not less than 6 inches, the lapped ends being securely wired together.

(d) Grouting of anchor rods shall be done in advance of concrete operations. After preparing the holes (see Paragraph 9-01 b (2)), each hole shall be filled with cement grout and the anchor rod forced to the bottom of the hole and vibrated until the grout is in contact with the rod at all points. The grout mixture shall be composed of 1 part Portland cement and 2-1/2 parts sand by volume, combined with water to a suitable consistency, and shall be placed as

approved by the contracting officer.

d. Protection. - Steel for reinforcement shall be new unrusted stock, free from loose scale. It shall be at all times satisfactorily protected from moisture until placed in final position. Exposed reinforcement intended for bonding with future work shall be protected from corrosion by heavy wrappings of burlap saturated with bituminous material.

10-19. Embedded items. - a. General - In addition to reinforcing steel, there shall be built into, or set, or attached to the concrete, gates, pipes, catch basin and manhole frames and covers, and other metal objects as shown on the drawings or ordered. All necessary precautions shall be taken to prevent these objects from being displaced, broken or deformed. Before placing concrete, care shall be taken to determine that any embedded metal or wood parts are firmly and securely fastened in place as indicated. They shall be thoroughly clean and free from paint or other coating, rust, scale, oil, or any foreign matter. The embedding of wood in concrete shall be avoided whenever possible, metal being used instead. The concrete shall be vibrated around pipes and other metal work so as to eliminate rock pockets and secure perfect adhesion. Gravel drains shall be adequately protected from intrusion of concrete into them. Payment for this work is included in the several items for gravel drains and metal work.

b. Sheet metal sockets. - Where pipe hand-railings are shown on the drawings, sockets of thin sheet metal shall be placed in position as indicated. The cost of furnishing and installing these sockets will be covered by the contract price for concrete in which the sockets are placed.

10-20. Expansion and contraction joints. - Expansion and contraction joints shall be constructed at such points and of such dimensions as may be indicated or required. The method and materials used shall be subject to the approval of the contracting officer and the materials shall conform to Federal specifications wherever applicable. Unless otherwise indicated on the drawings, or required by the contracting officer, expansion joints shall be made by the use of approved asphaltic, smooth-surfaced, roady roofing and promoulded sponge rubber or compressed cork filler 3/8-inch thick. For concrete poured when the atmospheric temperature is above 50 degrees F., the joints shall be made with lightweight roofing, weighing 35 pounds per square, and when the temperature is below 50 degrees F., the joints shall be made with heavy-weight roofing, weighing 55 pounds per square, except that in either case the 3/8-inch rubber or cork filler shall be used for the 2 feet adjacent to top surfaces and 1 foot adjacent to vertical surfaces. In no case shall corner protection angles or other fixed metal embedded in the surface of the concrete and bonded, be continuous through an expansion joint.

10-21. Measurement and payment. - a. Portland Cement (Item 29). - (1) The quantity to be paid for under Item 29 will be the number of

barrels of cement used in all parts of the work unless specifically excepted. For purposes of payment, a barrel of cement shall be considered 376 pounds net of cement. The unit contract price for the cement shall include payment for all expenses incidental to delivering the cement upon the work in which it is to be used.

(2) Only the cement furnished for work to be done under Items 28 and 30 to 36 inclusive, will be paid for under Item 29. Cement used for mortar or grout under other items will be included in the payment for those items.

b. Concrete (Items 30 to 36 incl.) - See Section XI.

c. Reinforcement (Item 37). - (1) The quantity to be paid for under Item 37 will be the number of pounds of steel placed in accordance with the drawings or orders, measured as specified. It will not include any waste material due to the fact that the lengths supplied are too long for their purpose. The quantity paid for shall, however, include extra metal in laps, where authorized, due to the fact that single bars would be unreasonably long. The weight of the deformed bars shall be computed in accordance with Section I-5 of Federal Specifications QQ-B-71a. Wire or metal clips, and other supports necessary to hold the steel in place will not be considered as reinforcement but shall be furnished by the contractor without additional compensation. The unit contract price for Item 37 shall include royalty if any, the cutting, placing, fastening in position, coating, and all other work and materials connected therewith (see Paragraph 10-18 a).

(2) Payment shall also include all costs of labor and materials required for grouting of anchors and dowels into rock or concrete.

SECTION XI. CONCRETE STRUCTURES (Items 30 to 36 incl.)

11-01. General. - a. Concrete structures shall be constructed as shown on the drawings and in accordance with modifications designated by the contracting officer. Concrete shall conform to all the requirements of Section X for concrete of the class specified. Surfaces of concrete shall be finished as specified in Paragraph 10-15, except as otherwise specified in this section or indicated on the drawings.

b. Measurement and payment. - (1) The quantity to be paid for under Items 30 to 36 inclusive, will be the number of cubic yards of concrete satisfactorily placed within the required limits. No deductions will be made for openings having a cross-sectional area less than that of a 12-inch pipe, nor for the space occupied by reinforcing steel, miscellaneous metal, wood nailing strips, or by other materials required to be built into the concrete. The unit contract prices shall include payment for all costs of furnishing materials, erecting and removing forms, mixing and placing concrete, except that cement, reinforcing steel and other metal work are included under other items. (See Paragraph 10-21).

(2) Line "A" indicated on the drawings is the "pay line" where concrete is adjoining rock excavation and represents the maximum limit measured from the finished concrete face. Any concrete placed outside the limits of the pay line will not be included in the measured quantities for payment, except as authorized by the contracting officer, but payment for same will be included in the unit contract prices.

(3) Additional payment will be made to the contractor for any ordered replacement of concrete damaged by overtopping of cofferdams (see Paragraph 2-06), provided such damage was not caused by negligence or carelessness of the contractor; and further provided that such damage to concrete did not result from inadequate construction of cofferdams to the specified effective elevations (see Paragraph 2-02). The additional payment allowed for ordered replacement of damaged concrete will be at the respective prices stipulated for the item. Any ordered excavation of damaged concrete preliminary to its replacement will be paid for at the unit contract price for rock excavation under Item 8. The quantity to be paid for will be the number of cubic yards for the item of work measured as the contracting officer may direct.

11-02. Concrete in tunnel lining-typical section (Item 30). - a. Description. - This classification includes the Class "A" concrete containing 1-inch maximum size aggregate, placed between the stations 7 + 74 approximately and 8 + 59.33 approximately and between the stations 9 + 50.67 approximately and 11 + 22 approximately as shown on the drawings. The forms shall be lined with steel or pressed wood, "Masonite" or equal, or shall be standard collapsible steel tunnel forms of an approved make. Concrete fins formed at the joints of the form lining shall be removed after the forms are stripped. Piping and other metal work shall be set and concreted in place.

b. Measurement and payment. - See Paragraph 11-03 b.

11-03. Concrete in tunnel lining - transition section (Item 31). -  
a. Description. - This classification includes the Class "A" concrete containing 2-inch maximum size aggregate, placed between the stations 8 + 59.33 approximately and 9 + 30.67 approximately and below Elevation 505 approximately as shown on the drawings. For forms and workmanship see Paragraph 11-02. The semi-spool conduit linings, gate frames and other metal work shall be set and concreted in place.

b. Measurement and payment. - For Items 30 and 31, the volume of concrete to be paid for will be the volume computed between the inside surface of the concrete and the surfaces designated by Line "A" on the drawings, and limited between stations 7 + 74 approximately and 11 + 22 approximately, as indicated on the drawings. Payment for Class "A" concrete placed between the stations 7 + 74 approximately and 8 + 59.33 approximately and between the stations 9 + 30.67 approximately and 11 + 22 approximately as indicated on the drawings will be made at the unit contract price for Item 30. Payment for Class "A" concrete placed between the stations 8 + 59.33 approximately and 9 + 30.67 approximately and below Elevation 505 approximately as indicated on the drawings, will be made at the unit contract price for Item 31.

11-04. Concrete in gate shaft (Item 32). - a. Description. - This classification includes the Class "B" concrete containing 2-inch maximum size aggregate, placed between Elevations 505 approximately and 544.5 approximately as shown on the drawings. The gate guides and other metal work shall be set and concreted in place.

b. Measurement and payment. - For Item 32 the volume of concrete to be paid for will be the volume computed between the inside surface of the concrete and the surfaces designated by Line "A" on the drawings and limited between Elevations 505 approximately and 544.5 approximately as indicated on the drawings. Payment for Class "B" concrete placed between these elevations will be made at the unit contract price for Item 32.

11-05. Concrete in operating house substructure (Item 33). - a. Description. - This classification includes the Class "A" concrete containing 1-inch maximum size aggregate, placed in the permanent work constructed above Elevation 544.5 approximately, except the work classified as operating house superstructure. Concrete fins formed on exposed surfaces shall be removed after the forms are stripped. For operating house superstructure see Section XII.

b. Measurement and payment. - For Item 33 the volume of concrete to be paid for will include all permanent work constructed above Elevation 544.5 approximately, except the work classified as operating house superstructure, contained between the inside surface of the concrete and the surface designated by Line "A" on the drawings, and including the net volume in the columns, walls, air-shaft, floors and beams. Payment for Class "A" concrete placed in the operating house substructure will be made at the unit contract price for Item 33.

11-06. Concrete in Intake and Outlet Structures (Item 34). - a. Description. - This classification includes the Class "A" concrete containing 2-inch maximum size aggregate, placed between stations 7 + 12 approximately and 7 + 74 approximately, and also limited between stations 11 + 22 approximately and 11 + 39 approximately as shown on the drawings. The forms for the water passages and for the exposed exterior walls shall be lined with pressed wood, "Masonite", or equal. Concrete fins formed at the joints of the form lining in the water passages and on the exposed faces of the retaining walls shall be removed after the forms are stripped. Piping and other metal work shall be set and concreted in place.

b. Measurement and payment. - For Item 34 the volume of concrete to be paid for will be the volume computed between the inside surface of the concrete and the surfaces designated by Line "A" on the drawings and limited between stations 7 + 12 approximately and 7 + 74 approximately and, also, limited between stations 11 + 22 approximately and 11 + 39 approximately, as indicated on the drawings. Payment for Class "A" concrete placed in these locations will be made at the unit contract price for Item 34.

11-07. Concrete in Spillway Weir, Spillway Lining and Retaining Walls (Item 35). - a. Description. - (1) This classification includes the Class "B" concrete containing 4-inch maximum size aggregate, except for concrete of minimum thickness for which 2-inch maximum size aggregate shall be used, placed between the limiting lines and grades and in the locations as shown on the drawings or directed by the contracting officer. Concrete fins formed on exposed surfaces shall be removed after the forms are stripped.

(2) Depending upon field conditions disclosed during the excavation of the spillway channel, the contracting officer may require the sides and bottom of the spillway channel to be lined with concrete about 2 feet thick throughout the extent of the required rock excavation for the spillway channel. For such concrete 2-inch maximum size aggregate shall be used. This concrete will be in addition to the amount estimated for Item 35 in Paragraph 1-05 and will be paid for at the unit contract price for Item 35 (see Paragraph 11-08 b)

b. Measurement and payment. - See Paragraph 11-08 b.

11-08. Concrete in Road and Bridge Structures (Item 36). - a. Description. - This classification includes the Class "A" concrete for bridge floor, abutments, and other details, and for culvert headwalls, placed between the limiting lines and grades and in the locations as shown on the drawings or directed by the contracting officer. Forms for exposed surfaces shall be lined with pressed wood, "Masonite", or equal. Concrete fins formed on exposed surfaces shall be removed after the forms are stripped. Corrugated metal pipe or other culverts shall be installed as provided for on the drawings.

b. Measurement and payment. - For Items 35 and 36 the volume

of concrete to be paid for will be the volume computed between the limiting lines and grades, as shown on the drawings or directed by the contracting officer. The computed volume will be to Line "A", where shown on the drawings, or if not shown, will be the net volume of concrete placed to the ordered lines and grades. Payment for Class "B" concrete and Class "A" concrete placed within the limiting lines and grades of the structures specified in paragraphs 11-07 and 11-08 will be made at the unit contract prices for Items 35 and 36 respectively.

## SECTION XII. OPERATING HOUSE SUPERSTRUCTURE (Item 38).

12-01. Work included. - a. The contractor shall furnish all labor and materials and do all work required to construct the operating house superstructure as shown on the drawings or ordered. The work includes the furnishing and installing of all door and window frames, doors, windows, glazing, builders' hardware, roofing and any other work, materials and labor not specifically mentioned that are necessary to complete the operating house superstructure in the finished condition as shown on the drawings or ordered.

b. One bronze plaque for the front or south exterior of the operating house will be furnished by the Government and shall be set by the contractor as indicated on the drawings.

12-02. Stone Masonry. - a. Quality. - The masonry for the walls and chimney shall be rubble granite masonry as shown on the drawings. The stone to be used shall be sound, clean, strong, durable granite, of satisfactory color and texture and free from any defects which might affect its strength or injure its appearance. The stone shall be obtained from the spillway excavation area or other source approved by the contracting officer and broken to suitable size by the hammer. No stone shall be obtained from any quarry for use in the work until a sample shall have been submitted to the contracting officer and approved by him in writing. The number and distribution of the different-size stones in the masonry shall be essentially as shown on the drawings to give the finished work a uniform and pleasing appearance. The radial shape and size of the stones in the arch rings in the gable ends of the structure shall correspond as closely as possible with those shown on the drawings.

b. Stone sizes. - The sizes of the stones at each of the exterior corners of the operating house, at the window and door jambs, at corbels, chimney or other special locations, shall be such that the vertical and horizontal joints will be located as shown on the drawings. Stones in arch rings shall be so sized and placed that each arch will be symmetrical about its center line and so that all arches in the structure will be similar in appearance. Generally, stones shall be sized and placed so that the walls of the structure shall have the uniform thickness as shown on the drawings within a tolerance of two inches over or under, one-half of this tolerance to be allowed from the uniform plane of either outside or inside wall surface; the minimum dimension of either of the exposed faces of any stone shall be not less than two-thirds of the maximum dimension unless otherwise specifically shown on the drawings or required by the locations of the joints; and at least 50 per cent of the stones shall closely approximate a maximum dimension of 16 inches, and a minimum dimension of 10 inches on either exposed face except that back of the dressed joints, headers may taper to a width and thickness of not less than three-fourths of the minimum dimension of the face of the header.

c. Joints. - So far as practicable in the opinion of the con-

tracting officer, the width of all joints shall not exceed  $3/4$  inch; joints shall be dressed to surfaces which will permit the allowable width for a depth of not less than 3 inches back from the neat face. Joints shall also be dressed so that back of the allowable width required the joint is nowhere over 3 inches wide.

d. Setting. - The setting of stone masonry shall be done by competent, experienced men and in strict accordance with the drawings and specifications. Each stone shall be brushed clean and thoroughly drenched with clean water immediately before laying and carefully bedded in a full bed of mortar. Stones shall be lowered carefully into their mortar beds so as not to injure their exposed faces nor jar adjacent stones. Stones shall be accurately set, with joints not exceeding the maximum width specified, and located as shown on the drawings for corners, jambs and other special locations. All joints shall be completely filled with mortar and shall be finished and pointed as the stones are laid and before the mortar shall have become hard. A sufficient number of suitable temporary wooden wedges shall be used in setting the stones to maintain alignment and a uniform width of joint and to prevent settlement in the joints. Window sills shall be bedded at the ends only until the adjacent mortar is set. Faces shall be kept free of mortar at all times. No stone masonry shall be laid between the fifteenth of November and the first of April or at any time during freezing weather or at night, except that if specific permission is obtained from the contracting officer and if such work is done in all respects as he directs, stone masonry may be laid during these periods but the contractor shall receive no extra payment therefor. All unfinished masonry shall be suitably protected during the colder months to prevent damage from freezing. The contractor shall keep masonry wet by sprinkling with water until the mortar shall have become entirely set and hard enough to prevent its drying and cracking.

e. Anchorage. - The contractor shall provide sufficient and proper anchors, dowels, clamps, etc., for securing the stone work in place and other structural features bearing thereon or attached, and shall do any drilling required to satisfactorily place such dowels and anchors.

f. Mortar for stone masonry. - Mortar for stone masonry shall be made in the proportions of one part Portland cement to two parts sand. The mortar may have just enough hydrated lime mixed in it to make it work evenly, but the quantity of lime shall not exceed 15 per cent of the weight of the cement. Mortar shall be prepared in such quantities that it can be used entirely before it shall have attained its initial set. Sand used in the mortar shall be natural white or clear sand, a sample of which shall be submitted for the approval of the contracting officer.

g. Protecting exposed surfaces. - The facing of all masonry which is permanently exposed to view shall be effectively protected from injury or disfigurement by the falling of stones, tools, mortar or other objects until the final acceptance of the work. The contractor shall build, at his own expense, timber or other acceptable coverings over the masonry if necessary for proper protection in the vicinity of derricks

and in any other places where faces are particularly liable to injury. All face stones shall be carefully handled so as not to mar the exposed faces. The erection of derricks and other machinery, or of centering and forms, or the landing and storing of stones or other heavy objects upon the surfaces of masonry under construction, or walking or working over them, will not be permitted until an acceptable time has elapsed for the setting of the mortar. Care shall be taken to avoid disturbing stones in any way after they have been set. Whenever a stone that has been set has its bond broken, it shall be taken up and reset.

12-03. Chimney. - The chimney shall be corbeled as shown on the drawings, and shall be constructed with two flues, both lined from the top of the corbeling to the top of the chimney with rectangular fire clay terra-cotta flue lining of nominal size 8-1/2 by 13 inches. The joints shall be well cemented and struck smooth inside. One flue shall be provided with a suitable cast iron clean-out door and thimble of size indicated on the drawings, at the base of that flue. A 7-inch thimble and cover for the smoke pipe shall also be installed in the same flue as indicated. A metal ventilating grille with movable louvers, of size indicated on the drawings, shall be installed in the second flue. A thimble of the proper size for the vent and means of operating the movable louvers from the operating floor shall also be provided. The chimney shall be topped with a cast stone cap as indicated on the drawings.

12-04. Cast stone. - a. Cast stone shall be used for window sills and lintels, for certain features around the entrance-door frame and other details as shown on the drawings. The cast stone shall be white or light-gray, and shall be placed as indicated on the drawings. The stone shall be uniform in color, sound, and perfect throughout; and subject to inspection before being placed in the work. All exposed surfaces shall have a rubbed finish. The cast stone shall conform in all respects to Federal Specifications SS-S-721, for architectural cast stone, Type 1. The contractor shall submit samples of the precast stone proposed to be used, for the approval of the contracting officer. Samples shall be not less than 8 by 12 inches. The contractor shall also submit evidence satisfactory to the contracting officer that the manufacturer who will furnish the cast stone has had at least 10 years' experience in designing and manufacturing cast stone of satisfactory appearance and durability.

b. Before purchasing the stone, the contractor shall submit, for approval of the contracting officer, prints (in quadruplicate) of drawings showing in detail the sizes, coursing, and full details of trim.

c. The casting, sizing, and coursing of all cast stone shall be done in accordance with the approved detail drawings. The stone shall be dressed and finished to a clean, smooth, uniform surface. Washes shall be cast or cut on the tops of copings, and drips on the undersides of projections where indicated on the drawings. All arrises shall be sharp and true. Anchors, cuts for accommodating steel work, and other incidental details shall be provided as required. Holes and sinkages shall be cast

or cut in stones for all anchors, clamps, dowels, etc. Lewis holes shall be cut or cast in stones weighing more than 100 pounds. Lewis holes or other holes shall be not closer than two inches to exposed faces of stone, and holes on exposed faces of stone are prohibited. The cast stone shall be made to check in dimension with all adjoining masonry. The carving or casting of the ornamental panels as indicated on the drawings shall be done in a neat workmanlike manner. All cast or carved ornamental parts of stone shall be finished at the producer's yard.

d. Mortar for setting the cast stone shall consist of one part Portland cement, three parts fine white sand, and 10 per cent by volume of hydrated lime.

c. Setting cast stone. - (1) Just before setting, each stone shall be brushed clean and thoroughly drenched with clean water. The stone shall then be accurately set, by competent stone setters, true to line and level, with full flushed joints. Each stone shall rest on a full bed of mortar placed under the center of the stone; the amount of mortar being sufficient to fill all anchor holes and to fill out to the edges of the stone on all sides. All stone shall be set with 1/4-inch joints raked out at the face to a depth of one inch and left for future pointing. The backs of stone facings shall be parged with neat cement where shown on the drawings. Where required in connection with the setting of heavy stones and projecting courses, in order to arrest the squeezing out of mortar beds, tipping or uneven setting of the stone; and wherever required in connection with stone bedded on structural members, to prevent cracking or spalling from unequal pressure, the contractor shall provide and install lead pads or buttons. These pads or buttons shall be made of soft, sheet lead, either round or octagonal in shape, and of the same thickness as mortar joints. They shall be set not less than one inch back from the face of the stone, and have the mortar bed spread around them. Wherever practicable, heavy stones shall be set with derricks and lifted with lewis plugs or hoisting loops. Where lewis plugs or hoisting ropes cannot be used, the stone shall be set with clamps. The use of pinch bars, except on the embedded parts of the stones, is prohibited. No defective stone, and no broken, spalled, patched or otherwise damaged stone shall be set in place. Rejected material shall be promptly removed from the work area.

(2) The contractor shall furnish and install all necessary anchors and dowels, as indicated on the drawings or as required by the contracting officer. Dowels shall be coated with an approved damp-proofing paint before being used.

(3) The contractor shall protect all cast-stone work from damage of every description until all construction work is completed. Any damaged work shall be replaced at the contractor's expense.

(4) After the stone has been set, all work shall be gone over by a competent stone mason, thoroughly cleaned, and all joints brushed clean, soaked with clean water, filled solid with pointing mortar, and dressed. The use of wire brushes, or acids and solutions which might

cause discoloration will not be permitted in cleaning stone.

(5) The mortar for pointing stone work shall consist of one part white "Medusa" cement or equal, two parts white sand, and 10 per cent of volume of hydrated lime. The mortar shall be colored as directed by the contracting officer.

f. Alternato. - (1) As an alternate the contractor may propose natural granite in lieu of the cast stone specified above. Granite shall be of a selected quality and a uniform light shade of gray with little hornblende in its composition. The contractor shall submit samples (not less than 8 by 12 inches) of the granite proposed to be used, for the approval of the contracting officer.

(2) The specifications for cast stone as set forth above shall apply respectively to the alternate stonework providing it is accepted in lieu of the cast stone.

12-05. Doors and windows. - a. The design of all doors and windows shall be submitted to the contracting officer for approval, and the contracting officer shall be furnished, in quadruplicate, with the shop drawings and details of these appurtenances. The work of fabrication shall not be started until such designs and drawings have been approved.

b. The entrance doors shall be of the vertical, swinging, ornamental type, supported at the jambs with hinges as shown on the drawings. All stiles and rails shall be constructed with rectangular steel tubing, internally reinforced at all corners and joints. All mitre joints and butt joints shall be welded and ground smooth. The metal panels shall be not less than 1/16 inch thick and of the sizes and shape indicated on the drawing. The quality of the material and workmanship shall be in all respects equal to the corresponding products of William Bayley, Springfield, Ohio, or the Truscon Steel Company, Youngstown, Ohio. The bottoms of the doors shall be provided with cold rolled bronze weather stripping as indicated on the drawings equal to the product of the Chamberlin Metal Strip Company.

c. The doors shall be painted and finished at the shop. The finish coat shall be green. The paint used shall conform to Federal Specifications of Group "TT". Samples of paint shall be submitted to the contracting officer for approval and selection. The doors shall be cleaned and primed with one coat of approved rust resistant paint baked on, and one coat of mineral filler shall be baked on and rubbed before assembling. The door shall be finished with two additional coats, baked on, the last coat being of the solid green color selected. The final varnish coat shall be rubbed to an eggshell gloss. If the paint on the door is marred in transit through faulty handling or improper protection, the finish shall be replaced at the contractor's expense to the satisfaction of the contracting officer.

d. The entrance door shall be provided with a suitable, pro-

perly fitted, non-skid cast-bronze saddle as shown on the drawings. It shall be secured in place with anchors as indicated. A detail shop drawing shall be submitted for approval to the contracting officer.

e. All windows shall be commercial horizontally pivoted steel type with 12 by 18 glass panes as indicated on the drawings, and shall be equal to the type manufactured by Truscon Steel Company, Youngstown, Ohio. Where indicated by diagonal lines on the drawings, the windows shall be provided with ventilating sections having bronze gravity latches and shall be provided with the necessary hardware for proper operation. The windows shall be adapted for glazing from the inside with glazing clips. All windows shall be caulked as shown on the drawings. The exposed metal of the windows shall receive in the shop one coat of red lead paint conforming with Federal Specifications of Group "TT". All sashes shall be glazed with flat drawn, double-strength glass, conforming in every respect to Federal Specifications DD-G-451, Type "B", "1" quality. Putty for glazing shall conform to Federal Specifications TT-P-791, Grade "A". All window glass shall be fastened with metal glazing clips, puttied and back-puttied.

12-06. Builders' Hardware. - a. The contractor shall furnish complete heavy bronze hardware for the doors including knobs, chain bolt, floor or wall bumpers, clamps, stops or checks, hinges of an approved type and other details of a complete installation. The contractor shall submit to the contracting officer for approval samples of the types of hardware he proposes to use.

b. The left, or inactive door, shall have four hinges, one long-chain bolt at the top, and one foot bolt. The right door shall have four hinges, one lock, one foot bolt and one door check.

c. Hardware shall be secured and placed with machine screws. Proper reinforcing plates shall be provided, where necessary, to receive the screws. Grouting around the foot bolt keepers in the floor shall be brought flush to the top. The hardware shall be approved by the contracting officer and shall be of bronze of the heavy solid type of sufficient strength for the purpose intended and shall be of P & F Corbin, Stanley or equal, with a finish as indicated on the following schedule:

8	--	1/2 Prs. Butts.....	Stanley BB 199 (6x6)
2	--	Foot Bolts.....	Corbin BB 4250-1/2 - 8"
1	--	Chain Bolt.....	Corbin BB 4252-1/2 - 8"
1	--	Lock.....	Corbin BB 742-991
1	--	Door Check.....	Corbin BB 105-1/2
2	--	Foot Bolt Keepers in Floor (to hold doors open) with a hinged cap.	
1	--	Foot Bolt Keeper without Hinged Cap (for left door closed).	

12-07. Structural steel. - a. All structural steel, including roof trusses, metals, entrance door channel frame, and other metal work of similar character shall be furnished and erected as indicated on the

drawings. Before commencing fabrication the contractor shall submit for the approval of the contracting officer, prints in quadruplicate of shop and erection drawings showing all details proposed. For material and workmanship of structural steel see Paragraphs 13-04 to 13-09 inclusive.

b. The structural steel channel door frame for the entrance door shall be furnished and installed as shown in detail on the drawings. The mitre joints shall be welded and ground smooth; each side shall be provided with 6 adjustable steel anchors attached to the channel frame as shown. The steel plate striking bar shall be attached as shown. The frame shall be constructed and assembled complete in the shop.

c. All structural steel work before leaving the shop shall be thoroughly cleaned of all loose scale and rust and given one good coat of red lead well worked into all joints and open spaces. The surfaces coming in contact shall be painted before being assembled for riveting. Pieces and parts which are not accessible for painting after erection shall have two coats of paint. Metal to be embedded in concrete shall be unpainted and shall be kept free from rust as specified for reinforcing steel in Paragraph 10-18 d. Any scale or heavy rust, loose mill scale or grease shall be removed just before embedding in concrete. For painting after erection see Paragraph 12-11 a.

12-08. Roofing. - a. The roof deck shall be constructed of precast concrete roof slabs of nailing concrete. Slabs shall be channel-shaped and of the type or equal to those manufactured by George Rackle & Sons Co., Cleveland, Ohio; or to the feather weight concrete insulating roof slabs manufactured by Federal-American Cement Tile Company, Chicago, Illinois. The nailing surface of the slab shall be 1-1/4 inches thick. The panels of the slabs shall be 2-1/2 inches deep and designed to carry a uniformly distributed load of 200 pounds per square foot. All slabs shall be made to fit the purlin spacing indicated on the drawings. No warped, cracked or broken slabs will be permitted in the roof. All joints in the slabs shall be cemented on the upper side with an approved brand of asphaltic cement, and when complete shall present a smooth surface ready for the application of the roofing material.

b. The roof shall be covered with smooth slate shingles 3/16 inches thick and 16 inches long. Random widths 8 inches to 12 inches may be used. No defective, broken or otherwise damaged shingles shall be set in place. The slate shall be of unfading green or gray color and shall conform to Federal Specifications SS-S-451, for roofing slate, Grade "A". A sample slate shingle shall be submitted to the contracting officer for approval.

c. Laying roof. - (1) The roof decking shall first be covered with 30-pound roof felt, conforming in all respects to Federal Specifications HH-F-191, Type II, laid parallel to the eaves, lapped 2-1/2 inches horizontally and 6 inches vertically, well-stretched and secured to the roof deck with galvanized large-headed roof nails. The nails shall be spaced according to standard practice. Over the roofing felt the slate

out shingles shall be laid 6 inches to the weather as indicated on the drawings, and securely nailed with copper nails to the roof deck. A slate course shall overlap the slate two courses below by at least 3 inches. The lower or first course shall be a double layer of slate shingles as indicated on the drawings.

(2) All flashing as indicated on the drawings or otherwise required, shall be 20-ounce copper conforming in all respects to Federal Specifications QQ-C-501, Type V, Class "A". The chimney shall be flashed and counterflashed. The roof ridge shall also be of 20 ounce copper and shall be roll-topped as indicated on the drawings. A layer of 30-pound felt shall be placed between the slate and the copper ridge. The ridge shall be nailed securely with copper nails and the heads of the nails shall be soldered. All seams shall be made with a single lock seal, sweat soldered.

(3) Diverting slate over the entrance doors shall be provided as shown on the drawings. The cornice flashing shall be fastened to the wood return cornices as shown on the drawings.

12-09. Electrical equipment and wiring. - The contractor shall install the lighting and power system to be furnished under Item 48.

12-10. Built-in materials. - All anchors, sleeves, nailing strips, plates, ducts, door frames, window frames, thimbles, conduits, outlet boxes, vents, etc., necessary for the completion of the work shall be built in and carefully grouted and calked or buried as the case may be.

12-11. Painting. - a. Painting shall be done only on surfaces which are thoroughly dry and clean. All metal to be exposed in the finished work shall be thoroughly cleaned and then thoroughly and evenly painted with two coats of approved paint to the satisfaction of the contracting officer. No painting shall be done until the condition of the surface to which the paint is to be applied has been approved. All field painting shall be done either by brush or spray. The work shall be done in a neat, thorough and workmanlike manner, and in no case shall any paint be applied in freezing, rainy or misty weather.

b. For shop painting of structural steel refer to Paragraph 12-07 c., for painting of entrance doors refer to Paragraph 12-05.

c. The roof trusses and any other exposed interior structural metal shall be painted gray. The green finish coat on exterior metal surfaces shall match the finish color of the entrance doors (see Paragraph 12-05). The paint used shall conform to Federal Specifications of Group "TT"; samples of paint shall be submitted to the contracting officer for approval and selection.

12-12. Installation of gate hoists and standby unit. - The contractor shall install the gate operating hoists and standby unit to be furnished under Items 40 and 41, including suitable dowels and

anchors for anchorage of the concrete base of the standby unit to the floor of the operating house. The contractor shall also install the miscellaneous metals to be furnished under Items 43 and 46.

12-13. Protection of work. - The contractor shall be responsible for damage to the operating house from the time that he begins work and until the work is accepted. He shall provide a watchman at the site at such times as the condition of the building so requires, and the building shall be kept locked when no work is being done in it. Temporary doors or screens for all openings shall be furnished and installed to keep out the weather when and where directed. Care shall be taken to prevent material or debris of any sort falling into the shafts. All of the work shall be thoroughly cleaned and swept at completion, and all glass shall be washed, leaving the building clean and ready for use.

12-14. Payment. - a. The dividing line between the superstructure and substructure of the operating house shall be the floor at Elevation 565.5 approximately with the following exceptions: The concrete and steel reinforcement in the curbs, between Elevation 565.5 approximately and 566.0 approximately, shall be included in bid Items 33 and 37; and rails and fastenings around gate wells and stair wells shall be included in bid Items 43 and 44; the metal threshold shall be included in bid Item 46; concrete and reinforcing steel in the air shaft shall be included in bid Items 33 and 37, and structural steel in the air shaft shall be included in bid Item 42; portions of door frame and threshold anchors below Elevation 565.5 approximately shall be included in bid Item 38.

b. The contractor will receive for all work, materials and incidentals required to construct satisfactorily the operating house as specified, the lump sum stipulated for Item 38. One-half of the sum will be included in estimates for payment as soon as the superstructure is satisfactorily walled and roofed and doors and windows installed so that it can be made satisfactorily weathertight. The other half will be included in the final estimate only.

SECTION XIII. STEEL FOR ACCESS BRIDGE (ITEM 39)

13-01. Work included. - The contractor shall furnish and erect, as shown on the drawings, the structural steel for the access bridge which provides access to the operating house.

13-02. Description. - The access bridge shall be of the deck plate girder type, approximately 95 feet in length, with structural steel framing and slab anchors, concrete floor, concrete abutments, bridge posts and railings, light standards and electrical conduits, fixed and expansion shoes, together with anchor bolts, pins and cast-iron scuppers. Camber shall be provided for dead loads only. The concrete work shall be as specified in Sections X and XI.

13-03. Drawings to be furnished. - a. The contractor shall furnish the following drawings in quadruplicate for the approval of the contracting officer.

- (1) Detail shop drawings for fabrication.
- (2) Match marking diagrams for erection.
- (3) Details of erection falsework.

The drawings for the bridge shall be approved by the contracting officer before any work on the bridge is started.

b. If the contractor desires to fabricate the structure in units of different sizes from those shown on the drawings, detailed shop drawings shall be submitted in quadruplicate for approval as above. Shop drawings shall show the desired changes completely detailed.

13-04. Materials. - a. Structural steel shall be new, unrusted stock, open-hearth steel of uniform quality, it shall meet the requirements of Federal Specifications QQ-S-711a; shapes, plates, bars and bolts shall be Class "A" and rivets shall be Class "C", unless otherwise indicated on the drawings. Welding will be accepted only where specified, or directed by the contracting officer, and approved only when done in accordance with the current requirements of the American Bureau of Welding.

b. Cold-rolled steel shall meet the requirements of A.S.T.M. Specifications A-108-36 for "Commercial Cold-finished Bar Steels and Cold-finished Shafting". Unless otherwise indicated on the drawings this material shall be used for rods, pins, keys and similar parts.

c. Steel castings shall meet the requirements of Federal Specifications QQ-S-681 a. All steel castings shall be annealed and shall be free from large or injurious blow holes.

13-05. Workmanship. - The workmanship of fabrication shall be equal to the best practice of modern bridge shops. Material shall be straightened, by methods that will not injure it before being laid out or worked in any

way. All portions of the work exposed to view shall be neatly finished. Structural steel work shall be riveted together as far as practicable at the shop, and erected in place on the work in accordance with approved standard practice.

13-06. Details of construction. - a. Punched work. - Unless general reaming is required by the drawings, all main material, forming parts of a member composed of not more than five thicknesses of metal, may be punched with a punch one-sixteenth ( $1/16$ ) inch larger than the nominal size of the rivets, whenever the thickness of the metal is not greater than three-fourths ( $3/4$ ) inch. Holes shall be clean cut, without torn or ragged edges.

b. Accuracy of punched holes. - Full size punched holes shall be punched with such accuracy that when the work is erected not less than fifty (50) per cent of the holes will permit insertion of a cold rivet of the nominal size required, without driving or reaming. The unfairness of rivet holes in assembled steel work shall not be more than one-eighth ( $1/8$ ) inch in more than five (5) per cent of the holes in any one connection. Unfairness of any hole more than one-fourth ( $1/4$ ) inch may be cause for rejection. In all cases, where a cold rivet cannot be inserted as specified above, the holes shall be reamed with a twist reamer without lubrication. Care shall be used to get the reamed holes truly normal to the contact surfaces and if long rivets are necessary, the contractor will be required to ream through satisfactory iron templates.

c. Reamed work. - Where general reaming is required by the drawings, holes shall be sub-punched and reamed in material forming a part of the section of main members if the thickness of the material is not greater than the nominal diameter of the rivet. Sub-punched and reamed holes for rivets having diameters greater than three-fourths ( $3/4$ ) inch shall be punched three-sixteenths ( $3/16$ ) inch smaller than the nominal diameter of the rivet. Outside burrs shall be removed. After assembling, sub-punched holes shall be reamed to a diameter one-sixteenth ( $1/16$ ) inch larger than the nominal diameter of the rivet. If oil or grease is used as a lubricant when reaming, it shall be applied so as not to soil surfaces which are to be painted. Burrs resulting from reaming shall be removed.

d. Drilled holes. - Drilled holes shall be one-sixteenth ( $1/16$ ) inch larger than the nominal diameter of the rivet. Burrs on the outside surfaces shall be removed. If members are drilled while assembled, the parts shall be held securely together while the drilling is being done.

e. Accuracy of reamed and drilled holes. - Reamed or drilled holes shall be cylindrical and perpendicular to the member. After reaming or drilling, eighty-five (85) per cent of any group of contiguous holes shall not show an offset greater than one thirty-second ( $1/32$ ) inch between adjacent thicknesses of metal.

f. Rivets. - Rivets, before driving, shall be of the diameter shown on the drawings, and free from furnace scale. Rivet heads shall be of approved shape, concentric with the shank, true to size, full, neatly formed and free from fins.

g. Shop assembling of members. - All surfaces of metal which will be in contact shall be cleaned and given a thorough coat of paint on each surface before assembling. Surfaces not in contact but which will be inaccessible after assembly shall be cleaned and given two coats of paint. End connection angles, stiffener angles, and similar parts shall be carefully adjusted to correct position and bolted, clamped or otherwise firmly hold in place until riveted. Parts not completely riveted in the shop shall be secured by bolts, insofar as practicable, to prevent damage in shipment and handling.

h. Drifting of holes. - The drifting done during assembling shall be only such as to bring the parts into position and not sufficient to enlarge the holes or distort the metal. If any holes must be enlarged to admit the rivets, they shall be reamed.

i. Shop riveting. - Rivets shall be heated uniformly to a light "cherry red" color, and driven while hot by power tools wherever possible. Rivet heads shall be full, neatly finished, concentric with the holes, and of uniform size throughout the work for the same size rivet. Rivets after driving shall be tight, completely filling the holes, with the heads in full contact with the surface of the member.

j. Facing of bearing surfaces. - The top and bottom surfaces of steel base plates, and cap plates of pedestals, shall be planed. Ends of members in contact with them shall be faced. Solo plates of beams and girders shall have full contact with the flanges. Solo plates and masonry plates shall be planed. Cast pedestals shall be planed on surfaces to be in contact with steel and shall have the surface to be in contact with masonry, rough-finished. In planing the surfaces of expansion bearings, the cut of the tool shall be in the direction of expansion.

k. Abutting joints. - Abutting joints in compression members and girder flanges shall be faced and brought to an even bearing. Where joints are not faced, the opening shall not exceed one-quarter ( $1/4$ ) inch.

l. Finished members. - The several pieces forming a built-up member shall fit closely and accurately together and the finished member shall be true to line and free from twists, bends and open joints. Cover plates shall be straight with a variation not to exceed one-sixteenth ( $1/16$ ) inch in five (5) feet, with a maximum variation not to exceed three-sixteenths ( $3/16$ ) inch at the center of the plate.

m. Web plates. - Web plates of girders having cover plates may be one-half ( $1/2$ ) inch less in width than the distance back to back of flange angles. At web splices, the clearance between the ends of the web plates shall not exceed three-eighths ( $3/8$ ) inch. The clearance at the top and bottom ends of web splice plates shall not exceed one-fourth ( $1/4$ ) inch.

n. Web stiffeners. - End stiffener angles of beams or girders and stiffener angles intended as supports for concentrated loads shall not

be crimped and shall be milled or ground to secure an even bearing against the flanges or flange angles. Fillers under stiffeners shall fit within one-fourth ( $1/4$ ) inch of flange angles.

o. Pins, rollers and rockers. - Pins and rollers shall be accurately turned to the dimensions shown on the drawings and shall be straight, smooth and free from flaws. The final surface shall be produced by a finishing cut. Nuts for pins shall be chamfered and hexagonal in shape. Rockers shall be made to the exact dimensions shown on the drawings. Their contact surfaces shall be finished true and smooth.

p. Boring pin holes. - Pin holes shall be bored true to the diameter shown on the drawings, smooth and straight, at right angles with the axis of the member and parallel with each other unless otherwise required. The final surface shall be produced by a finishing cut. Boring of holes in built-up members shall be done after the riveting is completed. Pin clearances shall be as shown on the drawings.

q. Threads and nuts. - Screw threads shall make close fits in the nuts. Pilot and driving nuts shall be furnished for each size of pin in such numbers as may be necessary to protect from injury the threads of all pins.

13-07. Inspection and tests. - a. Inspection and tests will be required by the contracting officer in accordance with Article 6 of the contract. The contractor shall notify the contracting officer in writing ten (10) days in advance of the date on which he expects to start fabrication. During the time between the date of such notification and the date of the beginning of the work, the Government inspector will make surface inspection of materials, and any material cut or work done before such inspection, may be rejected. When required by the contracting officer, the contractor shall furnish, if available, certified copies from the manufacturer's record, of tensile and bending tests of the material to be used. If such certified copies are not available the contractor shall provide from such material all test pieces that the contracting officer may require or select. Facilities for inspection of materials and workmanship in the shop shall be furnished by the contractor to the contracting officer and the Government inspector, and they shall be allowed free access to all parts of the premises where material under their inspection is being manufactured.

b. During the fabrication of the structural steel work, the contracting officer will require as many inspections as he considers necessary. The acceptance of any material or finished members by the Government inspectors shall not be a bar to their subsequent rejection, if found defective, either during fabrication or erection. Rejected material and workmanship shall be replaced promptly.

c. Every facility shall be furnished by the contractor for inspection of riveting and erection in the field and any part which may have been injured in shipment shall be replaced or repaired to the satisfaction of the contracting officer. Acceptance of any material or member

shall not bar its subsequent rejection if found to be in any manner defective.

13-08. Erection. a. Handling material. - The loading, transporting, unloading and storing of structural material shall be conducted so that the metal will be kept clean and free from injury.

b. Plant and equipment. - The contractor shall provide the falsework, all tools, machinery and appliances necessary for efficient handling of the work. The falsework shall be designed, constructed and maintained to carry the loads which will come upon it. Upon completion of the work and before final acceptance, the contractor shall remove all falsework to the satisfaction of the contracting officer.

c. Steel erection. - The contractor shall erect, rivet and adjust all metal work complete in place, in accordance with approved standard practice, on falsework and blocking so placed as to give the required camber to the girder span. The parts shall be carefully handled to avoid injury or damage, and shall be accurately assembled as shown on the drawings. All splices and field connections shall be securely bolted before riveting is started. Splices and field connections shall have one-half (1/2) of the holes filled with bolts and cylindrical erection pins (half bolts and half pins) before riveting. Drifting shall be only such as to draw the parts into position and not sufficient to enlarge the holes or distort the metal. Unfair holes shall be reamed or drilled.

d. Field riveting. - See Paragraph 13-06 i. Rivets of the proper length shall be carefully selected.

e. Pin connections. - Pilot and driving nuts shall be used in driving pins. Pins shall be so driven that the members will take full bearing on them. Pin nuts shall be screwed up tight and the threads burred at the face of the nut with a pointed tool.

f. Misfits. - The correction of minor misfits involving non-harmful amounts of roaming, cutting and chipping will be considered a legitimate part of the erection. The contractor shall be responsible for all misfits, errors and injuries and shall make the necessary corrections and replacements.

g. Bearings and anchorage. - (1) Masonry bearing plates shall not be placed upon bridge seat bearing areas which are improperly finished, deformed or irregular. Bearing plates shall be set level in exact position and shall have a full and even bearing upon the masonry; they shall be placed on a layer of canvas and red lead applied as follows: Thoroughly swab the bridge seat bearing area with red lead paint and place upon it three (3) layers of twelve (12) or fourteen (14) ounce duck, each layer being thoroughly swabbed on its top surface with red lead paint; place the superstructure shoes or pedestals in position while the paint is plastic.

(2) Unless otherwise shown on the drawings, anchor bolt holes shall be drilled after the superstructure is in place. The bolts shall be set accurately and fixed with Portland cement grout completely filling the holes. The location of the anchor bolts in relation to the slotted holes in the expansion shoes shall correspond with the temperature at the time of setting the shoes. The nuts on anchor bolts at the expansion end of the span shall be adjusted to permit the free movement of the span.

13-09. Painting. - a. Shop painting. - Painting shall be done only on surfaces which are thoroughly dry and clean. All structural steel before leaving the shop shall be thoroughly cleaned of all loose scale and rust and given one good coat of red lead well worked into all joints and open spaces. The surfaces coming in contact shall be painted before being assembled for riveting. Pieces and parts which are not accessible for painting after erection shall have two coats of paint. Anchor bolts and steel surfaces which will be in contact with concrete shall not be painted.

b. Field painting. - (1) All metal to be exposed in the finished work shall be thoroughly cleaned and then thoroughly and evenly painted with two coats of approved paint to the satisfaction of the contracting officer. No painting shall be done until the condition of the surface to which the paint is to be applied has been approved. All field painting shall be done either by brush or spray. The work shall be done in a neat, thorough and workmanlike manner, and in no case shall any paint be applied in freezing, rainy or misty weather.

(2) The paint used shall conform to Federal Specifications of Group "TT" appropriate for the purpose and use intended; samples of paint shall be submitted to the contracting officer for approval and selection. The finish coat shall be a green field paint approved by the contracting officer.

13-10. Payment. - a. Payment for furnishing and installing the structural steel and castings for the access bridge will be made for the number of pounds in place at the unit contract price per pound for Item 39, and shall include the cost of all necessary falsowork, fabrication and erection, shop and field painting, and all labor, material, and equipment necessary for the steel superstructure.

b. The weight to be paid for will be the weight of metals computed from the approved shop drawings based on a weight of 489.6 pounds per cubic foot.

c. Payment for concrete and reinforcing steel will be made as provided for in Paragraph 10-21 and 11-08. Payment for bridge railing and posts will be made as provided for in Paragraph 16-07 b. Payment for electric wiring and conduits will be made as provided for in Paragraph 17-07.

SECTION XIV. FURNISHING AND INSTALLING GATES AND ACCESSORIES (Item 40)

14-01. Work included. - The contractor shall design, furnish and install two (2) service gates, each complete with frames, frame extensions, guides, guards, hoists and accessories; one (1) emergency gate complete with two (2) emergency gate frames, frame extensions, guides, guards, accessories and one (1) traveling gate hoist; and one (1) set of conduit linings complete as indicated or as listed on the drawings, or required by these specifications.

14-02. Description. - a. The gates are to be installed as indicated on the contract drawings. The service and emergency gates shall be designed so as to be self-closing under all heads up to and including the maximum hydrostatic head of 76 feet. Addition of weight to the gate to aid in closing and the application of any mechanical force to effect a complete seating of the gate against the seal plates will not be allowed. When sealed, the gates shall be practically watertight. Sliding between the seal plates on the gate and the seal plates on the gate frame will not be permitted and shall be prevented by an adjustable bottom seal plate which can be adjusted from the downstream side of the gate after installation. The lower edge of the gates shall be suitably streamlined to reduce turbulent flow and to eliminate vibration when the gate is operated in a partly open position. Provisions shall be made to drain or fill such parts of the gates where freezing water can cause damage.

b. The gate and frame shall be designed so that no recess will be required in the finished conduit floor. The service gates will be operated by means of cable and fixed hoists. The emergency gate will be operated by means of cable and traveling hoist. The gates shall be similar to and equal in all respects to the Broome Self-Closing Sluice Gate as manufactured by Philips and Davies, Inc., Kenton, Ohio.

c. Materials used in the construction of the gates and their accessories where not otherwise definitely stated shall conform to the applicable Federal specifications (see Paragraph 16-02).

14-03. Service Gate Details. - a. Gates. - The gates shall be constructed of horizontal wide flange beams securely attached by means of angles and rivets to side plates of not less than 5/8-inch thickness. The side plates shall extend beyond the horizontal framing in an upstream direction and shall be supported by knee bracing to the horizontal beams as indicated on the drawings. The outer face of the side plates shall serve as mountings for the roller-race castings and the extended side plates shall support an angle to be used as a buffer. The buffer angle shall have 1/8-inch clearance with the upstream guard angle on the gate frame. Two roller-race castings shall be mounted on each side plate, properly reinforced by means of turned bolts. The roller-race castings shall be of semi-steel with a corrosion resisting steel insert hardened to about 230 Brinnell on the pressure side. Provision for adjusting the tension of the roller chain shall be provided. The roller chain shall be constructed with 4-inch diameter rollers turned and ground to a tolerance of  $\pm 0.001$  inch. The rollers shall be made from corrosion re-

sisting steel of about 230 Brinnell hardness. The chain links shall hold the rollers on  $1\frac{1}{8}$ -inch centers and shall be of the same material and hardness as the rollers. Link separators shall be of Naval brass and link pins shall be of Tobin bronze or equal. A protective cover shall be provided for each roller assembly to completely inclose the mechanism except on the pressure side. This cover shall be securely bolted to the roller race. At least two clip angles shall be fastened to each side plate, one near the top and one near the bottom of the gate, to keep the gate in the guides when raised above the guard angle. Clearance between the clip angles and the downstream face of the roller-race mounted on the gate frame and gate guide shall be about  $\frac{1}{2}$  inch. The streamlined lower edge of the gate shall be formed from a steel plate at least  $\frac{5}{8}$  inch in thickness and the plate shall be securely welded to the lower gate beam. The adjustable bottom seal shall be of cast manganese bronze (Federal specification QQ-B-726) and shall be securely bolted to the lower downstream face of the gate with corrosion resisting steel bolts with bronze nuts. Adjustment shall be obtained by at least four large bronze adjusting screws. Seal plates on the gate shall be of Naval brass at least four inches wide on the sides of the gate and 5 inches wide at the top of the gate. The plates shall be securely riveted to the gate with countersunk rivets of the same material, with no sharp fillets and then machined to a true plane surface. A suitable dogging arrangement, consisting of a link inserted in each side casting, manually operated to seat against a curb angle on the basement floor, shall be provided for each service gate.

b. Gate Frames. - (1) The gate frame shall be semi-steel with minimum frame section of  $1\frac{1}{2}$  inch and web thickness of not less than 1 inch and may be cast in one or more pieces at the option of the contractor. If cast in more than one piece, sections must be accurately doweled and bolted together. The flange on the downstream face of the frames shall match the flange on the conduit lining castings, and the drilling must match that of the conduit-lining-casting flange. The slope of the seal pad shall be determined by the contractor and shall be sufficient to insure that the gate will be completely self-closing. Forces causing seating of the gate shall exceed forces resisting seating by at least 50 per cent. Rolling friction in seating computations shall be assumed to be 0.05 times the maximum water pressure against the gate. The pads for the seal plates and the roller race shall be accurately machined in the proper relation to each other to receive the seal plates and the roller race. The side seals of the gate frame shall be of the same material as the side seals of the gate and shall be at least 4 inches in width. The top seal plate shall be at least 5 inches in width; it shall be securely attached to the frame by two lines of countersunk rivets or bolts of the same material with no sharp fillets. The roller race shall be of corrosion resisting steel of about 230 Brinnell hardness and shall be securely attached to the frame by countersunk bolts or rivets of the same material. The inside edge of the roller race shall project to within about  $\frac{1}{4}$  inch of the side plate of the gate, to act in conjunction with the clip angle on the side plate, to keep the gate on the roller race when the gate is raised above the upstream guard angle. The surface of the seal plates and roller race shall be accurately finished in the proper relation to each other. The bottom of the gate frame shall have a manganese bronze insert to serve as a bottom

seal in conjunction with the adjustable bottom seal plate on the gate. Grouting plates shall be provided to a point 4 feet above the roof of the conduit to facilitate installation. These plates shall be fabricated of structural steel plates and angles, attached to the frame casting and the upstream guard angle, and conforming to the dimensions of the gate recess as indicated on the drawings.

(2) Cast gate-frame extensions shall be provided to extend three-quarters of the height of the gates above the gate frames. The extensions shall act as supports for the roller race and they shall be accurately doweled and securely bolted to the top of the gate frames. The roller races on the gate-frame extensions shall be of the same material and hardness as the roller races on the gate frames, and shall be similarly attached, and their finished surfaces when assembled, shall be strictly in the same plane as the roller races on the gate frame. The inside edge of the roller race shall extend to within 1/4 inch of the side plate of the gate.

c. Gate Guides. - The gate guides shall be fabricated from structural steel and shall consist of a "T" shape with suitable anchors, with a roller-race plate mounted thereon. The inside edge of the roller-race plate shall extend beyond the face of the "T" to within 1/4 inch of the side plate of the gate, to act in conjunction with the clip angles on the side plate in keeping the gate on the roller races. The gate guides shall extend from the top of the gate frame extension to the lower (basement) floor of the operating house.

d. Gate Hoists and Hoist Cable. - (1) Each hoist shall be capable of lifting its respective gate against the full hydrostatic pressure head of 76 feet above the gate sill, and shall be at least 30 ton capacity. It shall have a frame constructed of adequate structural members. The drum shall be of cast iron properly machined, of ample size, and grooved to suit the cable. The size shall be such that the first layer of rope shall raise the gate clear of the conduit opening. All gears shall be machine cut. The large gears shall be of cast steel cut from the solid and the small gears or pinions of forged steel. Bearings shall be self-aligning and provided with bronze bushings and suitable lubricating devices. The hoists shall be capable of being readily operated either by means of suitable hand cranks or by electric motor, and shall be provided with efficient safety devices and guards. A substantial sheet steel housing with suitable access doors shall be placed over the drum and gears so as to prevent, as far as practicable, up-draft of air from the gate well entering the building. This housing shall not extend over the motor or control apparatus.

(2) The hoist cable shall be a preformed extra pliable hoisting rope made of improved plow steel in compliance with Federal Specifications RR-R-571, Type XXXIII and thoroughly impregnated with a corrosion resistant lubricant satisfactory to the contracting officer. (See Federal Specification WW-L-751).

e. Gate Hoist Electrical Equipment. - (1) The hoist motors

shall be single speed, high-torque, low-starting current, open squirrel-cage type, designed for continuous operation with a 40 degree C. temperature rise, on 220-volt, 3 phase, 60 cycle alternating current. They shall be provided with moisture resisting insulation and non-corrodible fittings. The starting torque of the motors at rated voltage and frequency shall be not less than 125 per cent full load torque, and the break-down torque not less than 200 per cent full load torque.

(2) The controllers shall be the full magnetic reversing type, designed for across-the-line starting; and controlled by a three-way waterproof push-button station, so that the gates may be raised, lowered or stopped at any desired point in their travel. The controllers shall be provided with undervoltage and thermal load protection, accomplished by suitable relays. Overload relays shall be of the automatic reset type. Control apparatus shall have moisture resisting insulation and non-corrodible fittings. It shall be housed in drip-proof enclosing cases.

(3) The hoist motors shall be rated at the horsepower required to give a gate hoisting speed of 1 foot per minute. The hoists shall be provided with a solenoid brake so connected that it will come into action when the current is interrupted and so arranged that it may be manually released if necessary during hand operation of the hoist. A positive interlock shall be provided so that it will be impossible to move the gate electrically while the hand crank is engaged. Water-proof limit switches for upward and downward travel, and a gate-position indicator shall be included on the hoists. The gate position indicator shall be plainly visible from the push-button station.

(4) All electrical materials shall be suitable for use in a damp location where they will be subject to long periods of idleness and shall be in conformity with the current standard rules, regulations, and specifications of the American Institute of Electrical Engineers and of the National Electrical Manufacturers Association.

14-01. Emergency Gate Details. - a. Gate. - The emergency gate shall be constructed in accordance with the above specifications for the service gates (see Paragraph 14-03a). The emergency gate shall be provided with a dogging arrangement similar to that furnished for the service gates.

b. Gate Frames. - The emergency gate frames shall be constructed in accordance with the specifications for the service gate frames (see Paragraph 14-03b). Gate frame extensions shall also be provided even if not shown on the drawings.

c. Gate Guides. - The gate guides shall be of the same construction as for the service gates and shall extend from the top of the gate frame to the lower (basement) floor of the operating house.

d. Gate Hoist. - The emergency gate hoist will be of the traveling type provided with hand operation so arranged that the hoist can be moved from one gate well to the other with the gate suspended from it.

The hoist mechanism shall be similar in all details to the service gate mechanism. Electrical connections shall be made by means of a flexible cable running from a receptacle in the floor.

14-05. Conduit Linings. - a. The contractor shall furnish and install one complete set of semi-steel conduit linings as indicated on the drawings or as required by the specifications.

b. All surfaces marked on the drawings with a finish mark shall be accurately machined. The interior surface at the flanged joints between sections of the conduit lining shall match within one-quarter ( $1/4$ ) inch at any point, and all offsets shall be chipped or ground to a bevel of one on three to provide a reasonably smooth flow line.

14-06. Service and emergency gate furnishings and fittings. - a. The design shall provide for a satisfactory method of fastening the service and emergency gate frames during erection in the field. All bolts, special tools, jacks and other devices necessary to erect the gates and linings and to secure same while they are being concreted in place shall be furnished by the contractor. In addition the contractor shall furnish spacer bolts of the proper size to be used in maintaining correct adjustment of the second emergency gate frame and guides while they are being installed.

b. All bolts, nuts, screws, studs, pins, etc., shall be securely locked by satisfactory devices that will prevent loosening due to vibration.

14-07. Design. - a. The detailed design for gate and hoist shall be such that all working parts shall be readily accessible for inspection and repair, easily duplicated and readily replaced. Each and every part of the equipment shall be properly designed and suitable for the uses and service required.

b. The contractor shall submit the following design computations:

(1) Design computations for the service and emergency gates shall show the maximum stresses in the principal members of the gate framing, the average roller loading and the number of rollers considered as being in bearing, and the computations for the location of the hoisting sheaves.

(2) Design computations for the determination of the required inclination of the service and emergency gate seal to insure complete closure of the gate, showing the excess of closing forces over forces resisting closure.

(3) Computations shall be included showing the determinations of the hoisting speed by hand operation and by electric motor.

c. Unit stresses used in the design of structural members of

the service and emergency gates, frames, guides, and hoists shall not exceed one-sixth ( $1/6$ ) of the ultimate tensile strength of the steel used. The ultimate bending and compression strength shall be considered as equal to the ultimate tensile strength. The ultimate shearing strength shall be considered as being three-fourths ( $3/4$ ) of the ultimate tensile strength.

d. Unit stresses used in the design of steel castings shall not exceed one-sixth ( $1/6$ ) of the ultimate tensile strength of the steel used. The ultimate bending and compression strengths shall be considered as equal to the ultimate tensile strength. The ultimate shearing strength shall be considered as being three-fourths ( $3/4$ ) of the ultimate tensile strength.

e. A factor of safety of 15 shall be used for iron castings subject to severe shock or vibration and a factor of safety of 10 shall be used for iron castings subject to mild shock. A factor of safety of 6 shall be used for all other iron castings. Roller races and gate frames and gate-frame extensions shall be considered subject to severe shock and hoist drums shall be considered as subject to mild shock.

f. Bearing of rollers on roller races, shall not exceed one-tenth ( $1/10$ ) of the maximum load that can be applied to the rollers without an appreciable deformation to either the roller or the roller races.

g. Other unit stresses shall be in accordance with the best engineering practice for the part designed.

14-08. Drawings. - The drawings indicate the neat lines of the concrete structure for the gate setting and the necessary dimensions, the design head, the maximum operating head, a diagrammatic sketch of the gates in the raised and lowered position and the desired location of the service gate hoists. In addition to the description and general drawings submitted with his bid, the contractor shall furnish without charge to the Government, detailed drawings of: (1) the service and emergency gate, (2) the service and emergency gate frames including grouting plates, (3) the service and emergency gate frame extensions, (4) the service and emergency gate guides, (5) the service gate hoist, (6) the emergency gate hoist, and (7) the conduit linings. These drawings shall conform to the requirements of Paragraphs 14-02 to 14-07 inclusive, and shall include a complete and itemized list of all parts, showing the grade and class of material, or the make, where a standard article is proposed, that the contractor proposes to furnish. The item numbers in the list of parts shall be indicated on the drawings by means of a circle enclosing the item number and a solid light line connecting the circle to the part. Thickness of plates and sizes of structural shapes shall be shown either on the part or in the itemized list of parts. Proposed construction shall be clearly shown on the drawings by the liberal use of sections, enlarged details and by other means. Any item or part omitted from the drawings or list of parts, and needed to comply with the requirements of these specifications, shall be supplied by the contractor. Detailed drawings submitted by the contractor and approved

by the contracting officer shall become a part of these specifications.

14-09. Installation. - The gates, gate hoists, and accessories shall be assembled and installed complete as indicated on the drawings, under the supervision of a representative of the gate manufacturer, and as directed by the contracting officer. The frames of all gates, and all sections of the conduit linings shall be assembled in place and bolted together. All gates shall be placed in the assembled frames and securely bolted to them, and spacer rods shall be placed in the second emergency gate frame. The assembled units shall then be checked for alignment and elevation, and the two sets of structures shall be substantially anchored in place. After the form work is completed at the ends of the conduit linings the concrete shall be carefully placed around the frames and conduit linings bringing the top of the pour to the elevation specified. Spacer rods and bolts of the proper size to be used in the second emergency gate frame to maintain correct clearances and all bolts, special tools, jacks, and other devices necessary to erect the gates and linings, and any special anchors required to secure the assembled parts while they are being concreted in place, shall be furnished with the gates. The gate guides shall be assembled as the concrete is carried up in the gate shaft. The sections shall be properly riveted together and carefully aligned so that the working surface shall be a plane surface, smooth and free from irregularities throughout its length.

14-10. Inspection and tests. - a. The gate and accessories to be furnished shall be assembled in the shop as directed by the contracting officer, for inspection and to insure that all parts fit accurately and are in proper alignment. The joints in the gates required to be watertight shall be tested for leaks in the presence of the contracting officer or his representative. The test shall be made, prior to shop painting, by a jet of water from a nozzle at a minimum pressure of 60 pounds per square inch, directly applied to the joint being tested. Each gate shall be opened and closed to insure proper operation. The hoist shall be tested for lifting speed.

b. After completion of the operating house structure and the installation of all machinery, each gate shall be tested for satisfactory operation by being raised and lowered several times for its full length of travel. Any adjustments in the setting or installation required to secure satisfactory operation and tight closure of the gates shall be made by the contractor. The service gate and emergency gate hoists and motors shall be tested as directed and any adjustments or changes that may be required in the opinion of the contracting officer shall be done by the contractor.

c. The cost of all testing shall be borne by the contractor except for the Government's representatives, and shall be included in the contractor's bid price for Item 40.

14-11. Painting. - a. No painting shall be done on metal work to be embedded in concrete. The provisions of Paragraph 12-11 shall govern where appropriate.

b. For gates and gate guides there shall be applied one coat of metal filler, one shop coat of red lead, one field coat of red lead, and a finish coat of standard asphaltic black paint.

c. For gate hoists there shall be applied one coat of metal filler, one shop coat of red lead, one field coat of red lead, and one finish coat of selected engine enamel, dark gray or slate in color.

d. The field finish coat shall be subject to the approval of the contracting officer.

14-12. Payment. - a. Payment for designing, furnishing and installing the work included in Paragraph 14-01 shall be the lump sum stipulated for Item 40.

b. Payment of 50 per cent of the contract price will be made when the gates, hoists, accessories and conduit lining have been shop tested to the satisfaction of the contracting officer; an additional payment of 25 per cent of the contract price will be made when the entire equipment has been delivered to the site of the work, and the remaining 25 per cent of the contract price will be paid after final field tests have been made to the satisfaction of the contracting officer and acceptance has been made by him.

SECTION XV. GASOLINE-ELECTRIC STANDBY UNIT (Item 41).

15-01. Work included. - The contractor shall furnish and install in the operating house in the location indicated on the drawings one complete and fully equipped gasoline-electric standby unit.

15-02. General description. - a. The unit shall consist of a gasoline engine, directly connected by means of a flexible coupling, to a revolving field, synchronous type alternating-current generator with a direct-connected exciter. The generator shall be three-phase, sixty-cycle, 240 volt, 1200 r.p.m. with a rating of 31.3 kv.a. at 80 per cent power factor. The entire assembly shall be mounted on a cast-iron or welded structural steel bed-plate of suitable dimensions.

b. The unit shall be equipped with a starting motor and storage battery for self-starting; control equipment including rheostat for exciter field, voltage regulator complete, and all incidental ignition equipment. The gasoline engine shall be provided with a suitable detachable hand-crank, miscellaneous wrenches for special nuts, and complete equipment to operate.

c. Where applicable materials required under this item shall conform to the specifications listed in Section XVI.

15-03. Detailed description. - a. Gasoline Engine. - The gasoline engine for the standby unit shall be the product of a reliable manufacturer who can show at least five years experience in the successful manufacture of engines for similar duty. The engine shall be a four-cycle, industrial type, with not less than 4 cylinders, and shall have a brake-horsepower rating, at 1200 r.p.m., of at least 60 horsepower.

b. General details. - The principal parts of the engine assembly shall be as follows:

(1) Bed-plate. - The bed-plate shall be integral for engine and generator, it shall be provided with a drip edge and shall be of cast-iron or structural steel accurately machined for mounting the engine and generator.

(2) Crankcase. - The engine shall be equipped with a cast-iron pedestal-base type crankcase equipped with large removable side plates for easy inspection and adjustment of all working parts of the engine.

(3) Cylinders. - The cylinders and cylinder head shall be of a special cylinder-iron having a tensile strength of not less than 35,000 pounds per square inch.

(4) Crankshaft. - The crankshaft shall be a one-piece chrome-nickel steel forging properly heat-treated. It shall be counter-

weighted, and shall be dynamically and statically balanced. All bearing surfaces shall be of sufficient area and accurately ground to conform to standard practice for such work.

(5) Camshaft. - The camshaft shall be of forged alloy steel, heat-treated, and accurately ground on all journal bearings and cam profiles.

(6) Connecting rods. - The connecting rods shall be of high-grade forged alloy-steel, properly heat-treated.

(7) Pistons. - Pistons may be of light-weight cast-iron, or alloy. Each piston shall be equipped with at least four rings, three above the piston-pin and one below. The piston-pin shall be of tubular hardened steel, accurately ground and securely locked in place.

(8) Push rods and guides. - Push rods shall be of hardened steel and accurately ground. The push rod guides shall be bronze and of the removable type.

(9) Main bearings. The number of main bearings shall be one more than the number of cylinders. They shall be accurately fitted and anchored.

(10) Valves. - The valves shall be of special steel, of large area, accurately fitted, and ground to fit the valve insert seats.

(11) Flywheel. - The flywheel shall be of gray iron or steel, statically and dynamically balanced. It shall be securely attached to the crankshaft ahead of the flexible coupling.

(12) Coupling. - The flexible coupling shall be the fibre disk type or approved equal. The coupling shall be provided with a safety guard.

(13) Exhaust. - The exhaust manifold shall be a close-grained gray iron casting provided with suitable flange connections having straight pipe thread for exhaust pipe. The exhaust pipe shall be standard weight pipe of black wrought-iron, and that part above the operating floor shall be suitably covered with 85 per cent magnesia pipe covering 1-inch thick. The exhaust muffler shall be of an approved type of non-corrodible material; it shall be located inside the building on the piping below the operating floor. Insulating sleeves shall be provided in the concrete floor and wall.

(14) Cooling system. - The engine shall be provided with radiator, fan, and water pump. The cooling system shall be of sufficient capacity to cool the engine when operating at full load continuously, at ambient temperatures up to 100 degrees F., without boiling when ordinary water is used as a cooling medium.

(15) Lubrication system. - The engine shall be equipped with force feed lubrication to the main bearings, camshaft bearings, connecting rod bearings, valve operating mechanism, and gear trains. The oil shall be supplied under pressure by a positive gear-driven pump. The pump shall be removable from the engine without the necessity of dismantling the engine.

(16) Ignition. - The engine shall be equipped with high-tension ignition systems, consisting of an approved magneto with impulse starter device, and in addition, a distributor using current from the starting battery. The ignition shall be so controlled that either system of ignition may be employed by operating a switch.

(17) Fuel system. - The engine shall be provided with a mechanical fuel-pump and a hand fuel-pump to furnish fuel to the carburetor from the gasoline tank located beneath the operating room floor.

(18) Governor. - The engine shall be equipped with a governor of the hydraulic type which shall provide speed regulation within 5% of normal speed, when full load is suddenly thrown on or off. The speed variation from normal speed shall not vary more than 1% plus or minus at any continuous load.

(19) Gasoline tank. - The gasoline tank shall have a capacity of at least 50 gallons and shall be constructed of copper or other rust proof material. The tank shall be located directly beneath the operating room floor as near the engine as possible and supported by structural steel brackets on the wall. Provisions shall be made for filling the tank from the operating room floor. The contractor shall make all necessary connections from the gasoline tank to the fuel pump and carburetor system. A level gage of the dial type shall be furnished and installed on the engine instrument panel. The installation and design of the gasoline tank shall comply with the requirements of the National Board of Fire Underwriters. The drain connection shall be fitted with a pipe plug. Piping to the fuel pump on the engine shall leave the tank from the top.

(20) Engine accessories. - The following operating accessories shall be provided:

- (a) One electric starting motor.
- (b) One battery in case.
- (c) One oil cooler and filter.
- (d) One air filter and flame arrester.
- (e) One exhaust muffler and necessary piping to discharge exhaust gas down through the floor and thence to the outside of building (see drawings for location).
- (f) One tachometer.
- (g) One oil-pressure gage.
- (h) One gasoline gage.
- (i) One ignition switch with lock.

- (j) One temperature gage.
- (k) One crank.
- (l) One instrument board for mounting the gasoline gage, oil gage, temperature gage, tachometer, ignition switch, and starting switch.
- (m) One battery hydrometer for testing battery, and one set of necessary adjusting tools and wrenches complete for equipment furnished.

c. Generator. - (1) The alternating-current generator shall be of open construction suitable for mounting on the engine bed-plate; and of the type and capacity rating as indicated in Paragraph 15-02. It shall be capable of developing its full rating continuously with a temperature rise not to exceed 50 degrees C. from ambient; shall in all respects conform to the standards of the American Institute of Electrical Engineers, and the National Electrical Manufacturers Association; and shall be the product of a reliable manufacturer who can show at least five years experience in the successful manufacture of electrical equipment of this type.

(2) The stator and rotor windings shall be insulated with class "A" insulation as defined by the American Institute of Electrical Engineers, and shall be moisture resisting.

(3) The exciter shall be mounted on an extension of the generator end bracket, and shall be direct-connected to the rotor of the generator. The exciter shall be shunt wound and of sufficient capacity to afford proper excitation to field coils at 150 per cent of the generator rating. It shall have a minimum capacity of two kilowatts and a terminal voltage of 125 volts D. C. The exciter shall be designed to operate with the voltage regulator as specified in Paragraph 15-03 c (7) to provide good voltage regulation up to 150 per cent of rated capacity of the generator.

(4) The armature windings shall be star-connected and the neutral wire shall not be brought out but grounded internally to the frame of the generator. The armature terminals shall be located on the left-hand side of the generator, reference being at the exciter facing the drive, and they shall be housed in a drip-proof terminal box, with a removable cover, to which conduit may be readily connected from below.

(5) The generator shall be equipped with bearings of ample size. The bearings shall be bronze or babbitt lined and shall be provided with positive self-lubrication by oil rings extending into an oil reservoir.

(6) Slip rings shall be of bronze or brass. Brush holders shall be of rugged construction and shall be provided with an adjustable tension spring which can be adjusted while the machine is in operation and then locked in position. If the brush holder is of ferrous material it shall be Parkerized or otherwise treated to prevent rust.

(7) A voltage regulator shall be furnished suitable for

installation on the back of the switchboard. It shall be similar and equal to the type G.D.A. as manufactured by the General Electric Company. A rheostat shall be furnished for the exciter field suitable for mounting on the back of the switchboard with control extending to the front of the switchboard (see Paragraph 17-03).

(8) All small parts and fittings shall be non-corrodible or shall be rust-proofed by a suitable process approved by the contracting officer.

d. Storage battery. - A 12-volt electric storage battery shall be provided, consisting of two 6-volt units. Each 6-volt unit shall have genuine hard rubber containers and wood and rubber separators, shall have a capacity of not less than 200 ampere-hours at a 20-minute discharge rate and shall be capable of discharging at 300 amperes for not less than 7.5 minutes at zero degree F. At the latter discharge rate, the voltage at the end of 5 seconds shall be not less than 4.7 volts.

e. Control equipment. - All control equipment for the electric generator and battery charger shall be mounted on the back of the switchboard with the controls extending through to the front as designated in Paragraph 17-03.

15-04. Design and drawings. - a. The detailed design of the standby unit shall be such that all working parts shall be readily accessible for inspection and repair, easily duplicated, and readily replaced with each and every part of the equipment of the machine properly designed and suitable for the uses and service required.

b. Before purchasing the gasoline-electric standby unit, the contractor shall furnish drawings and specifications for the proposed standby unit for approval. The drawings shall include the engine, generator, exciter, and all accessories, with dimensions of concrete base for mounting. Accessories shall be listed on the drawings by catalog number with name of manufacturer; and shall be accompanied by cuts and the manufacturer's specification for the accessories, all properly numbered to agree with the list as shown on the drawings.

15-05. Installation. - All work shall be neatly and accurately done and shall be in accordance with the highest standards of practice for equipment of the type to be furnished. The engine and generator shall be accurately aligned on the bed-plate and securely attached thereto. Provision shall be made for lifting the engine and generator, both separately, and the entire unit completely by a crane. The unit shall be erected accurately to line and level, including the concrete base required therefor; thoroughly secured; and every detail of the work of installation shall be done in a thoroughly workmanlike manner.

15-06. Inspection and tests. - a. The standby unit shall be inspected and tested in the shop in the presence of an authorized representative of the contracting officer, unless written notice is given by the contracting officer waiving this right. In that case, the tests shall be made and a typewritten record of them, including observations, calculations, results, and graphs shall be submitted to the contracting officer together with a

sworn statement from the manufacturer or person supervising the tests. The unit shall be tested for satisfactory operation under the following conditions:

(1) The engine shall be run at rated speed (1200 r.p.m.) for two (2) hours at twenty-five per cent (25%) overload of generator rating, on dynamometer test.

(2) The combined unit shall be run continuously for twenty-four (24) hours at full load.

(3) The valve setting and governor control shall be checked by means of a tachograph, with the entire unit operating under various loading conditions ranging from no-load to 25 per cent overload of the generator rating (see Paragraph 15-02).

(4) All tests shall be made using commercial standard gasoline, not special or high tests fuels.

(5) All required tests to determine that the generator, exciter, and electrical accessories conform with these specifications, and with the standards of the American Institute of Electrical Engineers and National Electrical Manufacturers Association shall be made before shop acceptance.

(6) Immediately after running tests for the engine the contracting officer or his representative may require that the engine be opened for inspection. Typewritten records of all the above tests, including all observations, calculations, results, and graphs shall be certified and submitted by the contractor to the contracting officer as soon as practicable after completion of the tests.

b. Field tests and trials shall be made after installation under the supervision of and as directed by the contracting officer. They shall be of sufficient loading and duration to demonstrate to the satisfaction of the contracting officer that the complete unit as installed is in conformity with the specifications.

c. The cost of all testing shall be borne by the contractor, except for the Government's representatives, and shall be included in the contractor's bid price for the item.

15-07. Painting. - Shop painting shall be in accordance with the provisions in Paragraph 14-11 applying to gate hoists. Such retouching as may appear necessary in the opinion of the contracting officer, shall be done with the same shade of paint as the shop coat. All finished surfaces to be exposed to the atmosphere during shipment shall be coated with a heavy rust preventive compound. Field painting of all exterior parts, except brass, bronze or finished surfaces shall be done in accordance with the provisions in Paragraph 14-11 applying to gate hoists.

15-08. Payment. - a. Payment for furnishing and installing the gasoline-electric standby unit shall be the stipulated lump sum bid for Item 41 and includes all costs of furnishing the concrete base therefor,

all necessary accessories not included in any other item.

b. Partial payments will be made as follows: 50 per cent of the contract price will be paid when the unit has been shop tested to the satisfaction of the contracting officer; an additional 25 per cent of the contract price will be paid when the unit has been delivered at the site of the work; and the remaining 25 per cent of the contract price will be paid after the field tests have been made to the satisfaction of the contracting officer.

SECTIONS XVI. METALS AND EMBEDDED ITEMS (Items 42 to 47 incl.)

16-01. General. - a. All metals, unless otherwise specified, shall conform to applicable Federal Specifications, and, when not covered thereby, to applicable A.S.T.M. specifications. All castings shall have the pattern or mark number cast on them. Unless otherwise authorized by the contracting officer, the scale weights of each casting or forging after machining shall be within 5 per cent of the weights as calculated from the dimensions specified or shown on the drawings. Wherever used in these specifications, the word "ton" shall mean two thousand pounds. Castings shall conform, at the minimum section thereof, to the following dimensional tolerances: where embedded in concrete, to within 1/8 inch; where not embedded in concrete, to within 1/16 inch of the dimensions shown on the drawings.

b. The various articles shall be furnished and placed as indicated on the drawings, except that dimensions given for floor openings and the frames and gratings for them are approximate only and are to be revised when the machinery is designed. The more important articles required are listed below and are required at the intake structure, in the gate shaft, the operating house sub-structure and superstructure, or elsewhere, but other articles, whether or not shown on the drawings, becoming necessary in the development of detailed plans and satisfactory construction, shall also be furnished; except materials and fittings specifically included under other items of the work.

16-02. Materials and Workmanship. - a. The articles included in Items 42 to 47 inclusive, other miscellaneous materials, and all metals for operating equipment or other uses in the work under this contract, for which the metal specification is not definitely stated elsewhere, shall meet the requirements of the following specifications where applicable to the use intended:

(1) Structural steel, refer to Paragraph 12-07 of these specifications and to Federal Specifications QQ-S-711a; shapes, plates, bars, pins and bolts shall be Class "A" and rivets shall be Class "C", unless otherwise required. Welding will be accepted only where specified or authorized, and approved only when done in accordance with the current requirements of the American Bureau of Welding.

(2) Cold-rolled steel, refer to A.S.T.M. Specifications A-108-36 for "Commercial Cold-finished Bar Steels and Cold-finished Shafting." Unless otherwise specified this material shall be used for rods, pins, keys and similar parts.

(3) Hot-rolled steel, for shafting, sleeves and rollers, refer to A.S.T.M. Specifications A-107-36 for "Commercial Quality Hot-rolled Bar Steels."

(4) Machine steel, same as for Hot-rolled steel.

(5) Steel, corrosion resisting, refer to U. S. Navy Specification 46-S-18b.

(6) Steel forgings, shall be of hot-rolled open-hearth steel forging bars conforming to A.S.T.M. Specifications A-18-30 for carbon steel and alloy steel forgings, Class "C", except that shafts of this material not otherwise specified shall be S.A.E. No. 1045 hot-rolled, open-hearth steel forging bars.

(7) Steel castings, refer to Federal Specifications QQ-S-681a.

(8) Iron castings, gray, refer to Federal Specifications QQ-I-651, class as indicated. Tensile tests and chemical analysis will not be required.

(9) Iron castings, semi-steel, refer to Federal Specifications QQ-I-656 for "Iron Castings, High Test (semi-steel)", class as indicated. Tensile tests will not be required.

(10) Malleable iron castings, refer to Federal Specifications QQ-I-666, Type "A".

(11) Steel rail track and fittings, shall conform to the standard A.S.C.E. sections and A.R.E.A. requirements.

(12) Chain and attachments, refer to Federal Specifications RR-C-271 of Type "A" and Grade "2" unless otherwise specified.

(13) Bolts, screws, and washers, refer to appropriate Federal Specifications and current standard practice, unless otherwise specified.

(14) Wrought-iron bars and shapes, refer to Federal Specifications QQ-I-686, Grade "B".

(15) Wrought-iron pipe, refer to Federal Specifications WW-P-441, Class A.

(16) Black steel pipe, refer to Federal Specifications WW-P-403, Type A, and WW-P-521.

(17) Cast-iron pipe, refer to A.S.T.M. Specifications A-44-04 Class A; for soil pipe refer to Federal Specifications WW-P-401.

(18) Sheet metal, refer to Federal Specifications QQ-I-696, Type II, Class A.

(19) Bronze, refer to appropriate Federal Specifications QQ-B0746, QQ-B-69, QQ-B-726, QQ-B-611 and QQ-C-591.

(20) Brass castings, refer to Federal Specifications QQ-B-621, Composition "B".

(21) Brass pipe, refer to Federal Specifications WW-P-351, Grade A, and WW-P-448.

(22) Naval brass, refer to Federal Specifications QQ-B-636; all brass for miscellaneous purposes shall be of this material unless otherwise specified.

(23) Commercial brass, refer to Federal Specifications QQ-B-611.

(24) Sheet copper, refer to Federal Specifications QQ-C-501, Type V, Class A.

(25) Zinc coatings (hot galvanized), refer to Federal Specifications QQ-I-696.

(26) Babbitt metal, refer to Federal Specifications QQ-M-161.

(27) Lead, refer to Federal Specifications QQ-L-171, Grade A.

(28) Solder, refer to appropriate Federal Specifications QQ-S-571 and QQ-S-551.

(29) Safety treads, shall be similar and equal to the "Mason Safety Tread, Ribbed Type" manufactured by the American Mason Safety Tread Company, Lowell, Mass.

(30) Valves, refer to Federal Specifications WW-V-76a.

(31) Other items, unless otherwise specified, shall conform to current standard practice for the material required and use intended.

16-03. Galvanizing and painting. - Galvanized iron or steel articles as indicated on the drawings, shall be galvanized by the hot process unless otherwise permitted. Injuries to the galvanizing shall be satisfactorily repaired at the contractor's expense. Provision shall be made for protecting threads either by counter-boring fittings, so as to cover threads or by cutting threads so as to make a very loose fit before galvanizing and carefully rerunning threads after galvanizing so as to leave a good coating all over threads. Hot galvanizing shall be of such quality as to endure at least 4 immersions in copper sulphate solution.

16-04. Furnishing and erecting miscellaneous structural steel (Item 42). - a. Trash racks, grilles, frames, gratings, and air vents for service gates in the tunnel shall be furnished and installed. General requirements are as follows:

(1) Grilles shall be detachable: At each anchor a hole shall be drilled and tapped for receiving 1/2-inch cap screws used in fastening the grille to the frame. The cap screws shall be of brass or bronze but furnished with the grilles and frames.

(2) Gratings over the service gate wells shall be prevented from sliding towards the open cowlway. When gratings are weakened by slots cut in their sides, suitable supports shall be welded under the grating to transmit load from unsupported members to the supported members. Gratings shall be Irwings Steel Flooring, Type "O", or equal. Plate covers shall be of non-skid steel plates, reinforced and provided with hand holes.

(3) An air vent shall be provided and installed below (downstream from) each service gate, leading from the opening in the conduit lining into the transition section at the bottom of the air shaft. The bottom angle iron flange shall be drilled for receiving 1/4-inch diameter round headed cap screws used to fasten the vent to the conduit lining. The vents shall be properly braced internally to maintain their shape during the placing of concrete; such bracing shall be removed after completion of concrete work.

(4) The door-frame in the stairway leading to the basement of the operating house shall be provided with a striking bar riveted to the channel.

b. Payment will be made as specified in Paragraph 16-09 b.

16-05. Furnishing and installing miscellaneous iron and steel (Item 43). - a. Ladder rungs, guard chains, pier nosings, U-bolts, portable ladder, malleable iron pipe fittings and connections, and metal door for stairway shall be furnished and installed. General requirements are as follows:

(1) Ladder rungs, hand grabs, and portable ladder shall be of open-hearth steel, shop bent or manufactured.

(2) Steel guard chains and posts installed around the openings to service gate wells shall be portable; eye bolts and snaps shall be of forged steel.

(3) Pier nosings shall be of semi-steel and be provided with bolts for assembling the several sections.

(4) All miscellaneous U-bolts shall be hot-dip galvanized after bending and welding.

(5) Malleable iron pipe fittings and connections shall be ball pattern and pin connected, unless otherwise shown on the drawings. Post connections at the floor, and caps used on the bottoms of sleeves embedded in the concrete or on top of cabin guard posts shall be standard screw-type. All fittings shall be of Crane Co. type or equal. Floor or wall flanges of screw type shall be anchored into the concrete with stud type expansion bolts consisting of a primary and one secondary expansive unit similar and equal to that manufactured by Ackerman-Johnson Company.

(6) The metal door for the stairway shall be complete

with hardware. (See Paragraphs 12-05 and 12-06).

b. Payment will be made as specified in Paragraph 16-09 b.

16-06. Furnishing and installing miscellaneous wrought-iron pipe (Item 44). - a. Leader pipe to the float-gage well, and hand railing shall be furnished and installed. The leader pipe to the gage well shall be a 3-inch hand-puddled wrought-iron standard grade pipe, similar and equal to that manufactured by A. M. Byers Company, and provided with malleable iron or wrought-steel couplings. Hand railing of wrought-iron pipe including sleeves for anchoring posts, where flanges are not used, shall be installed as indicated on the drawings.

b. Payment will be made as specified in Paragraph 16-09 b.

16-07. Furnishing and installing miscellaneous black steel pipe (Item 45). - a. Grouting pipes and bridge railing shall be furnished and installed. Miscellaneous black steel pipe shall conform to Federal Specifications (See Paragraph 16-02 a (16)).

b. Payment will be made as specified in Paragraph 16-09 b.

16-08. Furnishing and installing miscellaneous brass and bronze (Item 46). - a. The header to the leader pipe of the gage well, safety treads for stairways, and the bronze saddle for the threshold of the entrance door shall be furnished and installed. General requirements are as follows:

(1) Safety treads for the stair steps shall be provided with iron anchors to be embedded in the concrete, and brass or bronze screws for detaching or replacing treads on the anchors.

(2) Miscellaneous brass and bronze shall not include electric wiring fixtures or builders' hardware included under other items of the work. Unless otherwise permitted, all bronze shall conform to Federal Specifications (see Paragraph 16-02 a). Brass fittings, valves and other brass articles shall be of approved standard makes. Brass or copper pipes shall be seamless drawn annealed pipes of standard size and thickness. No patching or plugging of bronze castings nor any cold working of brass or bronze will be permitted. The bronze saddle for the threshold of the entrance door shall be made to fit the door frame and to match the weather stripping provided with the door.

b. Payment will be made as specified in Paragraph 16-09 b.

16-09. Furnishing and installing copper water stops (Item 47). - a. Copper water stops required for the construction joints and expansion joints of concrete work shall be furnished and installed. Copper water stops used in concrete expansion and construction joints shall be continuous, and shall be crimped for expansion joints only. Splicing of the water stops shall be done by overlapping, riveting and copper welding.

Unless otherwise specified on the drawings the material shall be 20-ounce sheet copper of approved standard. At expansion joints the crimp shall be filled with a mastic filler of "elastito" or equal as manufactured by Philip Carey Co., Cincinnati, Ohio. Copper water stops shall be placed in the expansion joints indicated on the drawings, and in all construction (field) joints between Stations 7 + 12 approximately and 11 + 31 approximately, and below Elevation 516 approximately as directed by the contracting officer.

b. The quantities to be paid for under Items 42 to 47, inclusive, will be the number of pounds, respectively, furnished and placed in the work in accordance with the drawings and requirements. Unless payment by computed weight is approved, weights shall be obtained by weighing on scales certified as to their accuracy. Where scale weights exceed computed weights only 5 per cent in excess of the computed weight will be allowed for materials to be paid for under Items 42 to 47, inclusive. Payment will be made at the respective unit contract prices. In calculating computed weights the following unit weights of the several materials will be used unless otherwise specified:

Structural steel	--	0.2833 pounds per cubic inch
Cast iron	--	0.2604 " " " "
Brass and bronze	--	0.310 " " " "
Wrought iron pipe	--	The weight per linear foot shown in Table I of Federal Specification WW-P-441
Black steel pipe	--	The weight per linear foot shown in Table I of Federal Specification WW-P-403 ✓
Copper water stops	--	20 ounces per square foot

SECTION XVII. LIGHTING AND POWER SYSTEM (Item 48).

17-01. Work included. - The contractor shall furnish and install, complete and ready for operation, all equipment and wiring for the lighting and power system of the operating house and access bridge as indicated on the drawings and as required by these specifications. The contractor shall make all necessary connections to the gate operating equipment and shall properly connect the gasoline-electric standby unit; and shall install all wiring, conduits, outlets, fixtures, floodlight projectors, power switchboard and light panel fittings, and junction boxes.

17-02. General description. - a. The complete power system includes conduits, wires and power switchboard complete with all wiring on the panels, instruments, bus work and switches, and all wire connections of external circuits to the several parts of the operating equipment.

b. The lighting system includes fixtures, cabinet, receptacles, floodlight projectors, access bridge lights, switches, conduits, wires and transformer, and the connection to the lighting switch and the power distribution switchboard.

c. The incoming power line to the operating house will be installed by other agencies and this work will not be included in the contract.

d. The electrical equipment will be subject to a wide range of local atmospheric temperatures and shall be suitable for such service conditions. The equipment for similar or allied service shall be of the same manufacture and type. When of the same type and rating, it shall be interchangeable.

17-03. Detailed description. - a. Standard rules and specifications. - Unless otherwise specified, all electrical materials, workmanship and tests shall be in conformity with the current standard rules, regulations, and specifications of the following authorities:

- (1) American Institute of Electrical Engineers,  
(33 W. 39th Street, New York, N. Y.)
- (2) National Board of Fire Underwriters, National  
Electrical Code.  
(85 John Street, New York, N. Y.)
- (3) National Electrical Manufacturers Association.  
(155 East 44th Street, New York, N. Y.)
- (4) Bureau of Standards, National Electrical Safety  
Code.  
(Superintendent of Documents, U. S. Govern-  
ment Printing Office, Washington, D. C.)
- (5) Insulated Power Cable Engineers Association.  
(420 Lexington Avenue, New York, N. Y.)

(6) Federal Specifications as cited herein,  
(Superintendent of Documents, U. S. Government Printing Office, Washington, D. C.)

(7) Copies of these rules, regulations, and specifications may be procured at the addresses as given, or may be seen at the U. S. Engineer Office, Providence, R. I.

b. Conduits. - (1) Conduits shall be located as indicated on the drawings or as directed by the contracting officer. Conduits with all necessary fittings will be required as follows:

(a) For operating house lights, floodlights, convenience outlets and access bridge lights.

(b) From the gasoline-electric generator set to the switchboard.

(c) From the switchboard to each service-gate hoist.

(d) From the switchboard to an outlet near the emergency gate well for the emergency-gate hoist.

(e) From the switchboard to a point six inches beyond the west end of the access bridge for the incoming feeder (see Paragraph 17-03 b (4) (d)).

(f) From a point on the inside of the wall of the operating house to a point six inches beyond the west end of the access bridge for the telephone line (see Paragraph 17-03 b (4) (d)).

(2) The conduits shall be hot-dip galvanized or Sherardized on both the inside and outside, and shall meet the requirements of Federal Specification WW-C-581a for "Conduit; Steel, Rigid, Zinc-coated." Conduit fittings or bodies shall be galvanized, Sherardized, or cadmium-plated high-test grey-iron castings of the types and sizes specified or shown on the drawings or required for the work to be done. They shall be approved by the National Board of Fire Underwriters, and be similar and equal to that manufactured by the Crouse-Hinds Company.

(3) Conduit sizes shall meet the requirements of Article 346 of the 1937 edition of the National Electrical Code, with the exception that no conduits smaller than  $3/4$ " shall be used. The main feeder conduit shall be 2-1/2" and the interior feeder and stand-by unit conduits shall be 2". The sizes indicated for these conduits on the drawings shall not apply.

(4) The installation of conduits shall comply with Article 346 of the 1937 edition of the National Electrical Code.

(a) All wires and cables shall be run in rigid conduits, forming a complete raceway from the cabinet or panel to the last outlet in the system. All conduits shall be concealed in walls or floors unless otherwise indicated. Conduits in masonry walls and floors shall be built-in complete with all necessary fittings at the time the

masonry work is being done (see Paragraphs 10-19 and 12-09.). Any exposed conduit shall be securely fastened and anchored to the structural portions of the building and shall be run parallel with or at right angles to the walls.

(b) All conduits shall be run with long bends where possible, and not more than four quarter bends shall be used on any run. All bends shall have a minimum radius of six diameters. If more than four bends are required, pull boxes shall be installed at points approved by the contracting officer. All conduit ends shall be reamed to remove burrs and obstructions after the threads have been cut. All conduit joints shall be made water-tight with an approved sealing compound. At all conduit terminals there shall be provided approved bushings or conduit fittings.

(c) Conduits run underground shall be of the size as specified on the drawings. They shall be laid as straight as possible, shall have no pockets which will collect and hold water and shall have no more than two quarter bends between outlets. The bends shall have a radius of not less than 30 inches. No reverse bends will be permitted. The conduit must be at least 24 inches below the ground surface and all joints shall be watertight. Suitable drainage shall be provided underground conduits by sloping them and providing drainage by means of suitable outlet bodies at all low points of conduit. Drilling holes in the conduit for drainage will not be permitted.

(d) The conduits on the access bridge shall be located as shown on the drawings and the feeder and telephone conduit carried to a point six inches beyond the back of the bridge abutment on the west side of the spillway channel. The conduits shall be rigidly supported by cast-iron pipe hangers attached to the cross bracing of the bridge as shown on the drawings. Conduit outlets and pull boxes shall be installed at suitable points to afford easy installation of wire for the access bridge lights and the conduit to the operating house. Pipe sleeves shall be installed in both access bridge abutments for the conduits. They shall have a slope sufficient to drain and have outlet bodies for drainage at low points. Expansion joints shall be provided in the feeder and telephone conduits at the west end of the bridge and for the bridge light conduit on the east end of the bridge. After installation and testing have been completed the ends of the incoming feeder and telephone conduit shall be capped. Exposed conduit on the walls shall be fastened to the walls by means of one-hole pipe straps of malleable iron, cadmium-plated, and anchor bolts.

(e) Conduits cut in the field shall have the ends properly machined with tools designed for the purpose, and all joints installed shall be of the same tapered construction as provided by factory cut material. All metal conduit runs shall have electrical continuity.

(f) Open conduit ends shall be capped in an approved manner to exclude dirt and moisture. No threadless fittings or running-thread couplings shall be used on runs of standard conduit.

(5) As soon as possible after the concrete has set in a given lift, each conduit shall be cleaned, inspected and tested by the contractor to ascertain its mechanical and electrical continuity, and freedom from obstructions. Any defects in material or workmanship shall be remedied immediately as directed by the contracting officer. After each duct line is completed, the contractor shall inspect and test each conduit in an approved manner and the conduit ends shall be capped.

c. Wiring. - (1) Wiring shall constitute the furnishing and installing of all cable and conductor terminals, junction boxes, supports, hangers for access bridge, racks or shelves, as shown or required, the making of all connections, grounds, and the proper placing, arranging and identifying of all material as specified or directed by the contracting officer. All wiring shall be in rigid conduit unless otherwise specified or shown on the drawings, or directed by the contracting officer.

(2) All wire used shall be copper, soft-drawn, and annealed with not less than 95 per cent conductivity. Wire sizes shall comply with Article 300 of the 1937 edition of the National Electrical Code. No wire shall be used that is smaller than No. 12A.W.G. except fixture wire which shall not be less than No. 18A.W.G. All wire run underground in rigid conduit shall be lead-covered cable.

(3) Wires and cable for power and lighting shall conform to Federal Specification J-C-106 for "Cable and Wire: Rubber Insulated Building Type, Superaging Grade (0 to 5,000 - Volt Service)". Wires for inside lighting shall be single conductor of the braided type saturated with flame-retarding, moisture-resisting compound. All power wiring and outside lighting circuits shall be rubber insulated, multiple conductor with standard stranding, and shall be totally enclosed with a lead alloy sheath. All wire and cable shall be in accord with the standards of the National Electrical Manufacturers' Association and the Insulated Power Cable Engineers Association.

(4) The contractor shall furnish samples of all proposed wire for approval.

(5) All wire and cable shall be shipped on reels or in coils, plainly marked for complete identification, including the wire or cable size, number of conductors, length, weight, thickness and character of the insulation and the name of the manufacturer.

(6) Solder for splicing or wiping shall conform to Federal Specification QQ-S-571, for "Solder, Tin Lead," Grade A for sweat conductor joints.

(7) Solder for brazing shall conform to Federal Specifications QQ-S-551, for "Solder, Brazing," Composition B.

(8) Silver Solder shall conform to Federal Specifications QQ-S-561b for "Solder; Silver" grade O.

(9) Rubber Tape shall conform to Federal Specification HH-T-111, for "Tape; Rubber, Insulating."

(10) Friction Tape shall conform to Federal Specification HH-T-101, for "Tape; Friction," Grade A.

(11) Cotton tape shall conform to United States Navy Department Specification 17-T-15 for "Tape Insulating, Linen Finish, Plain," thickness .007 inch.

d. Grounding. - Permanent and effective ground connections shall be provided for all metal cabinets enclosing electrical equipment, for equipment frames and housings, continuous runs of metal conduit, and elsewhere as specified or directed by the contracting officer. The contact area of all joints in grounding circuits shall provide a current carrying capacity not less than that of the connecting wire or cable, and the joints shall be bolted, soldered, or brazed, as specified or as directed by the contracting officer. All ground connections to equipment that may require removal for maintenance or repair shall be bolted to the equipment.

e. Lighting and outlets. - (1) The lighting panel-board shall be of the voltage and current rating and shall have the number of circuits as indicated or required. It shall conform to Federal Specification W-P-131, for "Panel-boards; Equipped with Automatic Circuit-Breakers" except that the name plates shall be of phenolic compound with engraved white enamel filled letters or embossed metal with white letters on a black background fastened to the cover plate with screws. The name plates shall be marked as directed by the contracting officer. The panel-board shall have side gutters of uniform width on four sides and ample dimensions to accommodate branch circuits and incoming feeders. The panel-board shall be surface mounted by means of anchor bolts and shall have steel trim and door with concealed hinges and flush locks, finished in black laquer. The panel-board shall have provision for eight branch lighting circuits and main protection. It shall be similar and equal to the "Nofuse Safety Panel-board" as manufactured by the Westinghouse Electric and Manufacturing Company.

(2) Plug receptacles for convenience outlets shall be rated 10 amperes, 250 volts, of duplex double "T" or "L" slot, straight pull-out, flush type with hot molded composition body and brass face plates not less than .06 inch thick. They shall be of standard manufacture, and approved by the National Board of Fire Underwriters. All plug receptacles shall be duplex Bryant No. 4832, with Crouse-Hinds DSS23 plate, or equal.

(3) Lamps shall be rated 115 volts of the watt rating shown or specified and shall conform to Federal Specifications W-L-101b, for "Lamps, Electric, Incandescent, Large, Tungsten-Filament."

(4) All lighting fixtures shall be installed as specified and at the locations indicated on the drawings. Fixtures shall be complete with all necessary fittings for attachment to the outlet boxes. Casings and fittings shall be of sufficient size to permit the free introduction of wires without abrasion of the insulation. Spun or drawn

parts, except for reflectors, shall be made of brass not less than 0.025 inch thick (No. 22 gage); reflectors shall be made of seamless steel not less than 0.025 inch thick (No. 22 gage). Reflectors shall be porcelain enameled, white on the inside and green on the outside. Holders, canopies and reflectors shall have full-rolled beaded edges. Fittings shall be constructed to hold the reflector, or reflector holder, independent of the socket, separable for easy wiring, and so that no wires are exposed.

(5) The operating-house superstructure overhead fixtures shall be supported from the outlet boxes located on the lower side of the bottom chord of the roof truss at points as shown on the drawings. The conduit and outlet bodies shall be supported by suitable hangers clamped to the bottom chord. These fixtures and the fixtures on the underside of the operating-house floor shall be Benjamin "Turnlox" Dome Reflectors, catalogue No. 7643, as manufactured by the Benjamin Electric Mfg. Company, or equal.

(6) The fixtures on the front of the operating-house superstructure shall be octagonal lanterns, attached to the operating-house by the brackets furnished with the fixtures. The fixtures shall be the lantern and bracket type, complete with wiring devices, catalogue No. WBS-829 as manufactured by the Novelty Lighting Corp., Cleveland, Ohio, or equal.

(7) The two floodlight projectors shall be Crouse-Hinds, Type LCE-1120, catalogue No. 42746, complete with HL 9018 spread lens, for use with 1,000 watt PS 52 lamps, or equal; and shall be provided with suitable bases, brackets and all other necessary fittings for rigid mounting as indicated on the drawings. The bulbs for the flood lights shall be 1,000 watt, 115 volt, PS 52 lamps.

(8) The four lighting fixtures on the access bridge shall be installed as shown on the drawings, and be the hexagonal post lantern, catalogue No. 759, made in bronze, as manufactured by the Novelty Lighting Corp., Cleveland, Ohio, or equal. The fixtures shall be installed complete with wiring devices and connected to the switch on the lighting panel-board in the operating-house.

(9) All sockets and receptacles shall be National Electrical Code Standard. Outside fixtures shall be of weatherproof construction.

f. Power switchboard. - (1) The switchboard shall consist of two sections. Facing the switchboard from the front, the panels left to right shall be arranged in the order stated below. Each panel shall control the circuits listed.

(2) Panel No. 1. - Combined generator, exciter and regulator panel for gasoline-electric stand-by generator unit. Capacity: 31.3 KV.A., 80 per cent power factor, 25 KW., 240 volts, 3-phase, 60-cycle, A.C. with 125 volt D.C. direct-connected exciter. Incoming feeders from the outside power source and from the electric generator of stand-by unit.

(3) Panel No. 2.

Three feeders for hoist motors.

One feeder for lighting transformer.

One feeder for battery-charging rectifier.

One feeder for lighting distribution panel.

(4) The panels shall contain the following equipment:

(a) Panel No. 1.

1. One voltage regulator (see Par. 15-03c(7)).

2. One rheostat for excitor field (see Par. 15-03c(7)).

3. One voltmeter with selector switch for reading line voltages.

4. One ammeter with the necessary current transformers and selector switch for reading the current in each line.

5. One ammeter for reading the field current in the generator.

6. One three-pole circuit breaker with inverse time delay and undervoltage trip for main power feed.

7. One three-pole, double-throw, back-of-board type switch for connecting the main bus to the outside power source or to the stand-by generator.

(b) Panel No. 2.

1. Three three-pole circuit breakers for the hoist motor feeders with thermal overload and short circuit trips.

2. One two-pole circuit breaker with thermal overload and short circuit trips for the lighting transformer feeder.

3. One two-pole circuit breaker with thermal overload and short circuit trips for lighting distribution panel feeder.

4. One two-pole circuit breaker with thermal overload and short circuit trips for battery charger feeder. (replacing fuses shown on the drawing).

5. One battery charging ammeter.

6. One battery charging rectifier (mounted on back) with control rheostat operated from the front of the switchboard.

(c) All incidental equipment necessary to complete the switchboard ready for operation.

(5) All panels shall be of 1/8 inch "stretcher-levoled" steel, 72 inches high, and of equal widths. The width of the panels shall be sufficient to give an efficient arrangement and a neat appearance of the equipment. The panels shall be rigidly fastened to a structural steel frame of angle iron and anchored to the floor and walls by means of expansion bolts. The panels shall have a 1/4-inch radius rounded edge for all front edges, and shall be similar and equal to N. E. M. A. standard construction. The panels shall be bolted together in a manner to effect a neat appearance. No unsightly gaps or wide joints shall be visible in the completed assembly.

(6) All panels shall be finished with one coat of filler and two coats of dull black marine finish.

(7) Name plates shall be furnished for all circuits. Name plates shall be black bakelite, with engraving filled with baked white enamel, or of equal construction.

(8) Two rubber insulating mats shall be furnished and placed in front and rear of the switchboard. They shall extend the full length of the switchboard. The mat in front shall be 36 inches wide; the one in the rear shall completely cover the floor area and shall be cut to fit the space between the switchboard and the walls.

(9) A suitable baked enamel wire-mesh structure of 1/8 inch steel wire, with 1-1/2 inch diamond-shaped mesh or the equivalent shall be furnished and installed to enclose the rear of the panels. This structure shall include a hinged wire-mesh door, equipped with a built-in lock. The frame shall be rigidly bolted to the panel-board frame, and anchored to the operating-house walls and floor by means of expansion bolts. The partition and door shall be similar or equal to that manufactured by the Acorn Wire and Iron Works of Chicago, Illinois.

(10) The contractor shall furnish and install in the rear of the switchboard a 7-1/2 kva., single-phase, 220/110 volt, dry type transformer and connect it to the lighting circuit on the switchboard. The transformer shall be similar and equal to the Type M single-phase transformer as manufactured by the General Electric Company.

(11) A battery charger of an approved make, similar and equal to the product of the General Electric Company, shall be provided and installed on the back of the switchboard. It shall be connected to the storage battery located on the gasoline-electric stand-by unit and be provided with a suitable circuit breaker of the type as specified in Paragraph 17-03f(14) located on the front of the switchboard. The battery charger shall be capable of operating on 220 volts A.C. and have a capacity of 12 amperes. It shall be provided with an adjustment to cut down the charging rate to 1 ampere, and an ammeter mounted on the switchboard to

indicate the direct current output. The battery charger shall be so designed that the battery will not discharge in case the A.C. power supply is interrupted, and shall be equipped with fuses for protection against overloads and short circuits. The charger shall be totally enclosed in a steel cabinet with hinged doors provided to make all parts easily accessible. The cabinet shall be made non-corrodibles.

(12) The main switch shall be a three-pole, double-throw, non-fusible, back-of-board type, as manufactured by the Westinghouse Electric and Manufacturing Company or equal. Each position of the switch shall be indicated by the position of the handle on the front of the switchboard. It shall be mechanically interlocked so that it cannot be operated unless the main circuit breaker is open.

(13) Circuit breakers shall be the AB "De-ion" circuit breakers as manufactured by the Westinghouse Electric and Manufacturing Company, or equal. The main breaker shall be of the carbon type, back-of-board mounted, manually operated from the front of the board and shall have inverse-time-overload and undervoltage trips.

(14) Meters shall be rectangular, semi-flush mounted, and have a five-inch scale, and similar or equal to the product of the General Electric Company.

(15) All fuses shall comply with Federal Specification W-F-791 for "Fuses; Cartridge, Inclosed, Non-renewable."

(16) The switchboard shall be of the dead-front construction. All wiring shall be on the back of the panels. All power conductors shall be of the proper cross section for the currents to be carried, and no wire shall be smaller than No. 8 A.W.G. Control wire shall be not smaller than No. 12 A.W.G. All control wire on the panels shall be run in wiring gutters provided on the sides of the panels. All busses shall be mechanically rigid and designed to carry the rated current of the circuit with a maximum temperature rise of 30 degrees C.

17-04. Design and drawings. - a. The detailed design of the lighting and power system shall be such that, so far as practicable, all parts shall be accessible for inspection and repair, easily duplicated and readily replaced. Each part of the equipment shall be properly designed and suitable for the uses and service required.

b. The contractor shall furnish to the contracting officer for approval, before any work is begun, four copies of schematic wiring diagrams and detailed drawings showing in full the switchboard layout he proposes to install, together with a list of all equipment, showing the type, size, rating, and manufacturer's catalogue number.

17-05. Installation. - The installation shall be in accordance with approved detailed drawings, of the materials as specified for the respective parts of the work, and shall be done in a workmanlike manner.

17-06. Tests. - a. Final tests shall be made of all electrical equipment and wiring, as directed by the contracting officer, to determine that all equipment is in good working order and in compliance with these specifications.

b. The costs of all tests shall be borne by the contractor, except for the Government's representatives, and shall be included in the contractor's bid price for the item.

17-07. Payment. - Under Item 18 payment for furnishing and installing the electric lighting and power system complete will be the lump sum bid for the item. Payment will be made in one sum after the equipment has been furnished, installed, connected and tested to the satisfaction of the contracting officer.

SECTION XVIII. MISCELLANEOUS (Items 49 to 54 incl.)

18-01. Furnishing and erecting highway cable guard rail and cable guard fencing - complete (Items 49 and 50). - a. Work included. - The contractor shall furnish and construct, as shown on the drawings or ordered, cable guard rail on the edges of the roadways and at such other places as directed. Under Item 49 is included the highway cable guard rail for the access road. Under Item 50 is included the cable guard fencing to be installed near the spillway, intake and outlet works.

b. Materials. - (1) The posts shall be of straight, sound, seasoned white oak, cedar, pitch pine, tamarack or locust. The posts shall be at least 6 inches in diameter at the small end with the bark removed. They shall be of the length indicated on the drawings and the bottoms shall be sawed off square. The bark shall be removed. Knots shall be hewn flush and smooth with the face. The posts shall be treated with a standard wood preservative of a creosote coal tar solution. This preservative shall be applied to the posts according to current standard specifications of the New Hampshire State Highway Department, substantially as follows:

All guard rail posts shall be given a preservative treatment from the bottom to 6 inches above the ground line as follows:

Posts to be treated must be seasoned air dry.

Special care shall be exercised to see that the portion treated is free from all inner and outer bark.

Posts shall be immersed to a point 6 inches above the ground line in:

(a) Hot bath of preservative material maintained at a temperature of approximately 200 degrees F. for one hour.

(b) Immediately after (a), transfer to cold bath of preservative material to be maintained at atmospheric temperature within the minimum and maximum limits of 50 degrees F. and 100 degrees F. wherein posts are likewise to be immersed for one hour.

The preservative material shall be a liquid grade of pure coal-tar creosote oil, specially refined for non-pressure treatments and conforming to approved standard requirements.

(2) Under Item 49, the cables shall be 3/4-inch in diameter, composed of three strands of seven wires each of double galvanized cast steel. It shall be in accordance with Federal Specification RR-R-571 and shall be Type III Galvanized. Cables of similar quality shall be supplied under Item 50, but of 1/2-inch diameter.

(3) All fittings, except nuts and washers shall be of galvanized drop forgings, conforming to Class "B" of "A.S.T.M., Designation A18-30". Nuts and washers shall conform to Paragraph 16-02. The fasteners on the posts shall be hook bolts with a threaded end of the size shown on the drawings and provided with nuts and washers.

The fasteners on the end posts or on the posts where intermediate anchorages are made, shall be steel provided with a bearing bracket as indicated on the drawings. Each cable shall be attached to its respective socket by a hot zinc socketing conforming to Federal Specifications RR-R-571 Paragraph I-12.

c. Construction methods. - The posts shall be securely set and the cables strung as shown on the drawings or as directed by the contracting officer. The posts shall be spaced as shown on the drawings; back filling shall be thoroughly tamped into place. The cable shall be drawn taut and the end posts shall be anchored by a precast concrete anchor block, all as shown on the drawings or other anchorage approved by the contracting officer. Dummy posts, other than those at the end of cable guard rails, shall be placed to mark culverts or elsewhere as ordered. Top ends of the posts shall be beveled according to the standard practice of the New Hampshire State Highway Department. Painting and finishing of the posts shall be done according to the standard practice of the New Hampshire State Highway Department for "Cable Railing, Wood Posts", substantially as follows:

After satisfactory erection the posts, when dry, shall be painted in an approved manner with two coats of the specified material. No painting will be allowed when the air temperature is 40 degrees F. or below. After the first coat of paint has been applied, at least 3 days shall elapse before the application of the second coat of paint.

Black paint shall be used for painting the guard rail posts from the ground line to the lower cable. The paint shall be homogeneous, free from water, and shall dry hard in 20 hours with a jet black color, and shall conform to approved standard requirements.

White paint shall be used for painting the guard rail posts from the lower cable to the top. The paint shall be composed of suitable pigment mixed with pure, raw linseed oil and approved drier, free from rosin, to cause the applied paint to dry in approximately 3 days.

d. Measurement and payment. - The quantity to be paid for under Items 49 and 50 will be the number of linear feet of cable guard rail satisfactorily completed in accordance with the requirements of Paragraphs 18-01 b and c. The unit contract prices shall include all materials, equipment, tools, labor and work incidental thereto; also all excavations for posts, backfilling and disposal of surplus materials. The measurement will be made from outer post to outer post to which cable is attached, with an additional allowance of 20 feet to cover the cost of anchoring at each anchor block, and to cover the cost of dummy posts to be set at anchor blocks at ends and with an additional allowance of 5 feet for each dummy post set other than those at the ends of the cable guard rail.

18-02. Furnishing and placing bituminous macadam road surface (Item 51). - a. Work included. - The contractor shall furnish and place the bituminous macadam road surface shown on the drawings, after the gravel base and shoulders shall have been placed in accordance with the provisions of Paragraphs 7-06 c. and d.

b. Specifications. - The materials and workmanship shall be in accordance with the current standard specifications and practice of the New Hampshire State Highway Department for "Bituminous Macadam Pavement Type D-1", substantially as follows:

The surface course shall be composed of broken stone and bituminous material applied by the penetration method, with a bituminous seal coat and covering of fine stone. The broken stone shall be of approved quality and clean, and shall meet the following requirements.

No. 1 Stone

Square openings	Per cent passing
2-1/2"	100
2"	55-80
1"	0-15

No. 3 Stone

Square openings	Per cent passing
3/4"	100
5/8"	95-100
No. 4	0-15

The bituminous material to be used in this work shall be an approved product for the purpose, either oil asphalt or refined tar.

c. Placing. - The required surface shall be placed to the ordered lines, grades and cross section shown on the drawings in accordance with the current standard construction methods of the New Hampshire State Highway Department for "Bituminous Macadam Pavement Type D-1", substantially as follows:

(1) A surface course of No. 1 stone shall be spread upon the prepared gravel base. Before the No. 1 stone is spread, the No. 3 stone shall be deposited alongside the road in convenient piles, from which it shall be spread on the surface course after the bituminous material is applied. No hauling will be permitted over the No. 1 stone after it has been spread.

(2) The No. 1 stone shall be spread from approved self-spreading vehicles. The course shall be spread and shaped to a true section of such depth that when the surface is finished, the depth shall be as shown on the drawings and the top shall be at the required grade. The No. 1 stone shall then be dry rolled with a three-wheel power driven roller weighing not less than ten tons. (See Paragraph 7-06 c.) Rolling shall continue until the course has been satisfactorily compacted to a uniform surface.

(3) No bituminous material shall be applied unless the entire depth of No. 1 stone is thoroughly dry and the air temperature is at or above 50 degrees F. After the No. 1 stone has been prepared as above, the penetration coat or bituminous material shall be applied at the rate of 2 gallons per square yard by an approved pressure

distributor, at approved temperatures appropriate for the grade of bituminous material used, and distributed under approved pressures.

(4) Immediately after the penetration coat of bituminous material has been applied, a thin layer of clean, dry No. 3 stone shall be broadcast over the treated surface in such quantity as to fill all the surface voids and just cover the treatment uniformly. The surface shall then be broomed to break up all clumps and produce a uniform covering, after which the pavement shall be rolled, in the same manner as specified for the rolling of No. 1 stone, until thoroughly compacted and bonded. Upon completion of the rolling the pavement shall have a smooth, even surface, free from ruts, depressions, or other irregularities.

(5) As soon as practicable after the No. 3 stone has been rolled, the pavement shall be swept clean of any loose material and shall be treated with a seal coat of bituminous material under the same conditions and in the same manner as specified for the penetration coat; except, that the rate of application shall be  $3/4$  gallon per square yard. Immediately after the seal coat has been applied, a thin layer of clean, dry No. 3 stone shall be broadcast over the surface in such quantity as to uniformly cover the surface with all the stone that can be made to adhere to the bituminous material; but care shall be taken to avoid an excess. This stone shall be broomed and rolled in the manner specified above, until an unyielding, uniform, and well-bonded surface is produced. Any damage to the finished surface caused by the contractor's equipment, shall be satisfactorily repaired at no expense to the Government.

d. Measurement and payment. - Payment for Item 51 will be at the unit contract price per square yard for bituminous macadam road surface, complete in place; which price shall include all materials, equipment, tools, labor, and work incidental thereto.

18-03. Furnishing and installing gages - tile and staff (Item 52). -  
a. Work included. - The contractor shall furnish and install the staff gage and tile gage at the locations shown on the drawings, and in accordance with the design and dimensions shown on the drawings.

b. Specifications. - (1) The staff gage shall be furnished and erected in sections as shown on the drawings. The 4" x 4" post standard for each section may be of cypress or other suitable lumber for the purpose, and before erection shall be treated with wood preservative throughout its length as specified in Paragraph 18-01 b. The facing of each staff gage section shall be enameled metal gage material of standard manufacture for the purpose. A sample of the facing at least 2 feet long shall be furnished to the contracting officer for approval before erection.

(2) The tile gage shall be furnished and erected in sections as shown on the drawings, and shall be constructed of ceramic mosaic tile of a quality approved by the contracting officer. The tile shall be assembled by pasting on sheets of paper in panels of 1-foot lengths; a sample shall be furnished to the contracting officer for approval before erection. Figure sheets as received from the

manufacturer shall be placed in an accurate mold on a glass plate and backed with cement mortar about 1-1/2 inches thick; the mortar shall be a 1 to 1 mixture of cement and sand of suitable consistency when combined with water, and shall be reinforced with expanded metal or wire fabric. Reinforcing shall extend beyond both edges of the mortar to form anchorages as shown on the drawings. After final set, molds shall be removed and the panels shall be cured immersed in water for a period of 10 days. The tile panels may be prepared in convenient lengths of even feet.

c. Payment. - For all work, materials and incidentals required to satisfactorily construct and install the articles as specified above, the contractor will receive the lump sum stipulated for Item 52.

18-04. Field office (Item 53). - a. Work included. - The contractor shall construct a temporary field office for the use of Government employees complete and ready for occupancy, in accordance with the drawings and these specifications. The contractor shall complete the field office within 30 days after date of notice to proceed, and will be required to maintain access at all times to the field office.

b. Excavation. - The contractor shall make the excavation for piers, foundations and trenches, as shown on the drawings or as staked in the field and shall grade the grounds so that surface water will drain away from the building.

c. Foundation. The building shall be set on foundation sills and posts as shown on the drawings.

d. Framing. - Lumber for framing and other woodwork shall be No. 2 common yellow pine. The framework shall be constructed in the manner shown on the drawings and shall be erected in a substantial manner.

e. Siding. - The siding shall be No. 2 common yellow pine sheathing laid diagonally and securely nailed at each stud. The siding shall be covered with composition mineral surfaced green shingles as shown on the drawings.

f. Roof. - The roof sheathing shall be No. 2 common yellow pine securely nailed at each rafter. The roof shall be covered with an approved make of ready roofing, conforming to Federal Specifications SS-R-501, "Grade A". The ready roofing shall be laid horizontally with well-lapped cemented joints and shall be securely fastened at the eaves as shown on the drawings.

g. Wall-board. - The inside of the outside wall and both sides of the partitions shall be covered with an approved make of wall-board securely fastened on the studs as shown on the drawings.

h. Floor and sub-floor. - The floor and sub-floor shall be laid as shown on the drawings. One thickness of building paper shall be laid between the sub-floor and floor and shall be well-lapped at joints. Building paper shall be "Noponsot" or equal, weighing at least 50 pounds per roll. Sub-floor shall be No. 3 common yellow pine sheathing.

Flooring shall be No. 2 common yellow pine, T. & G. sheathing, securely and tightly fastened to the joists.

i. Doors. - Outside doors shall be stock doors as shown on the drawings. Interior doors shall be stock two-panel doors of size and thickness shown on the drawings.

j. Windows shall be stock pattern of sizes shown on the drawings. Windows shall be hinged at the bottom and swing in at the top.

k. Screens. - All windows shall be screened with galvanized screen wire, nailed to the outside window casing and the edges of the screen covered with wood strips, 1/2 inch thick and not less than one inch wide.

l. Hardware shall be of stock design and conform in all respects to Federal Specifications FF-H-106 with U.S.1B finish. Doors shall be hung on two loose pin butts and provided with knobs, knob plates, mortised locks and strikes, key plates and two keys each. The outside door shall be provided with an upright rim knob lock and a rim night latch with six keys. Windows shall be provided with the necessary hinges, catches and chains.

m. Flashing. - The tops of all windows and outside door shall be flashed with tin 3 inches wide as shown on the drawings.

n. Plumbing. - (1) Materials shall conform to the following Federal specifications:

Galvanized Iron Pipe	WW-P-403
Malleable Fittings	WW-P-521
Fixtures	WW-P-541
Cast-iron Soil Pipe	WW-P-401

(2) Plumbing fixtures complete with necessary fittings and waste pipes shall be supplied as follows:

Closet - Washdown with low tank outfit #131D.

Lavatory - Cast-iron enameled, 21-inch with back wall hung outfit #1B21.

Shower head - Exposed type with mixing valve outfit #2MC.

(3) Hot water heater and tank. - The hot water heater shall be of the coil type, kerosene burning, of size recommended by the manufacturer for a 42 gallon storage tank. The size and type shall be subject to the approval of the contracting officer. The storage tank shall be of galvanized iron, 42-gallon capacity.

(4) Water system. - The contractor shall furnish all water for the field office. The water shall be potable and will be frequently tested for purity by the contracting officer. The water shall always be available at suitable pressure, and may be obtained either by tapping the contractor's water supply or by sinking a well and pumping it to the field office. The contractor shall furnish and install a 1-1/4 inch water line from the source of water supply to the fixtures in the field office as shown on the drawings. The line shall be placed in a trench of sufficient depth to prevent freezing during cold weather. Location of the well, if any, shall be subject to the approval of the contracting officer.

(5) Sewer system. - The contractor shall furnish and install an iron septic tank similar or equal to "Kaustine Standard Armo Iron Septic Tank No. 85", of approximately 550 gallon capacity with distributing box and 4" porous tile as shown on the drawing, and shall furnish and lay a 6-inch vitrified tile sewer line from the field office to the septic tank. The sewer line shall be laid true to line and grade and made up with tight cemented joints. A "Y" fitting shall be placed for future connection as shown on the drawings. The sewer line and "Y" fitting shall be placed in a trench of sufficient depth to prevent freezing in cold weather.

c. Lighting. - The building shall be wired with flexible metallic conduit for a two-wire, 110-volt system. Lights shall be placed where indicated and the wiring system carried to a disconnect switch panel with circuit breakers, as directed by the contracting officer. The necessary fixtures and switches of the type shown on the drawings shall be furnished by the contractor. All work shall be done in strict accordance with the requirements of the National Board of Fire Underwriters and the requirements of the local power company. The contractor shall make necessary connections and install the feeder line to his temporary lighting system. (See Paragraph 1-36).

p. Heating. - The contractor shall furnish and install coal-fired heaters of ample size at locations shown on the drawings. The size of the heaters will be subject to the approval of the contracting officer. The heaters shall be provided with smoke flues and hoods. Care shall be used in constructing the thimble and collar where the smoke pipe goes through the roof to provide a water-tight and fireproof installation.

q. Removal of building. - At the completion of the work covered by the contract, and when ordered by the contracting officer, the contractor shall remove the field office from the site of the work, fill up holes, and leave the premises in a neat and clean condition. All material resulting from removal of the field office, water and sewer connections will become the property of the contractor, if approved by the contracting officer.

r. Painting. - All exterior sash, doors and trim shall be given two coats of white lead and oil. The interior doors and standing trim shall be given one coat of oil stain. The entire wood floor shall be given one coat of hot paraffin oil, mopped on.

s. Payment. - Payment for the field office complete including furnishing water, the water system, sewer, septic tank and electrical connections, and for removal of the field office, will be made at the contract price for Item 53. The contract price shall include all materials, equipment, water pump if necessary, tools, labor and work incidental thereto; also all excavations for foundations, backfilling and disposal of surplus materials. Ninety per cent of the amount bid will be estimated upon completion of the house and the balance will be paid after its removal.

18-05. Cleaning up (Item 54). - a. Work included. - The contractor shall remove all construction equipment and all temporary structures built or used by him, shall remove rubbish of all kinds from the site of the work and the contract structures, and from any grounds which he shall have occupied within the limits of the work, and shall leave the site of the work in a satisfactorily clean condition. All materials salvaged shall be the property of the contractor.

b. Payment. - For all work, materials and incidentals required to clean up as set forth in a above, the contractor will receive the lump sum stipulated for Item 54. This sum will be paid with the final payment of the contract.

U. S. ENGINEER OFFICE,  
Providence, R. I.,  
June 20, 1939.

STANDARD GOVERNMENT FORM OF BID

(Construction Contract)

Place \_\_\_\_\_

Date \_\_\_\_\_

To the District Engineer,  
U. S. Engineer Office,  
819 Industrial Trust Building,  
Providence, Rhode Island.

In compliance with your invitation for bids dated June 20, 1939,  
and subject to all the conditions thereof, the undersigned \_\_\_\_\_

\_\_\_\_\_

a corporation organized and existing under the laws of the State of

\_\_\_\_\_

a partnership consisting of \_\_\_\_\_

\_\_\_\_\_

or an individual trading as \_\_\_\_\_

\_\_\_\_\_

of the city of \_\_\_\_\_

hereby proposes to furnish all plant, labor, and materials, and perform all work required for the construction of Surry Mountain Dam on the Ashuelot River about 34.6 miles above its confluence with the Connecticut River and about 5 miles northwest of Keene, in the Town of Surry in Cheshire County, New Hampshire, including all work indicated on the drawings or required by the specifications, and such incidental work as needed or ordered in writing by the contracting officer, in strict accordance with the specifications, schedules and drawings, for the consideration of the following prices:

SURRY MOUNTAIN

SCHEDULE OF BID ITEMS

ITEM	DESIGNATION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
1	DIVERSION AND CARE OF RIVER	JOB	-	<u>.46</u>	<u>15,000</u>
2	CLEARING AND GRUBBING	JOB	-	<u>.46</u>	<u>35,000</u>
3	COMMON STRIPPING	CU.YDS.	46,000	<u>.40</u>	
4	COMMON EXCAVATION - GENERAL	CU.YDS.	148,000	<u>.30</u>	
5	COMMON EXCAVATION - BORROW PITS "A", "B", "C" & "E" (INCLUDING HAUL)	CU.YDS.	533,000	<u>.30</u>	
6	COMMON EXCAVATION - BORROW PIT "D" (INCLUDING HAUL)	CU.YDS.	225,000	<u>.35</u>	
7	CUT-OFF TRENCH EXCAVATION	CU.YDS.	31,000	<u>.50</u>	
8	ROCK EXCAVATION - OPEN CUT	CU.YDS.	107,000	<u>1.30</u>	
9	LINE DRILLING AND BROACHING	SQ.FT.	500	<u>3.00</u>	
10	TUNNEL EXCAVATION (ROCK)	CU.YDS.	2,800	<u>12.00</u>	
11	GATE SHAFT EXCAVATION (ROCK) (EL. 498 to EL. 548)	CU.YDS.	700	<u>12.00</u>	
12	TIMBERING	M.F.B.M.	5	<u>100.00</u>	
13	(deleted, but item number retained)				
14	ROLLED EMBANKMENT	CU.YDS.	867,000	<u>.07</u>	
15	SELECTED PERVIOUS FILL	CU.YDS.	37,000	<u>.50</u>	
16	FILL (UNCLASSIFIED) - ACCESS ROAD	CU.YDS.	1,800	<u>.50</u>	
17	COMPACTED BACKFILL	CU.YDS.	3,500	<u>.50</u>	
18	SEMI-COMPACTED BACKFILL	CU.YDS.	6,400	<u>.40</u>	
19	GRAVEL FOR ROADS	CU.YDS.	2,000	<u>1.00</u>	
20	DUMPED ROCK IN EMBANKMENT	CU.YDS.	136,500	<u>.50</u>	
21	MISCELLANEOUS ROCK FILL	CU.YDS.	1,100	<u>1.00</u>	

*Imitation No. 122-39-302  
Bids Opening 7-27-37  
Award to  
A.I. Savin  
East Hartford  
Conn.*

<u>ITEM</u>	<u>DESIGNATION</u>	<u>UNIT</u>	<u>QUANTITY</u>	<u>UNIT PRICE</u>	<u>AMOUNT</u>
22	RIPRAP - HAND PLACED	CU.YDS.	1,600	5.00	
23	RIPRAP - DERRICK STONES	CU.YDS.	4,000	4.00	
24	GRAVEL AND CRUSHED STONE DRAINS	LIN.FT.	530	2.00	
25	TOE DRAIN (ROCK FILL)	CU.YDS.	5,900	1.00	
26	CORE OR ROTARY DRILLING IN ROCK OR CONCRETE	LIN.FT.	500	2.00	
27	ORDINARY DRILLING	LIN.FT.	2,300	1.00	
28	PRESSURE GROUTING	CU.FT.	2,000	1.50	
29	PORTLAND CEMENT	BBL.	12,800	2.30	
30	CONCRETE IN TUNNEL LINING (TYPICAL SECTION)	CU.YDS.	840	15.00	
31	CONCRETE IN TUNNEL LINING (TRANSITION SECTION)	CU.YDS.	670	15.00	
32	CONCRETE IN GATE SHAFT (EL. 505 TO EL. 544.5)	CU.YDS.	380	15.00	
33	CONCRETE IN OPERATING HOUSE SUBSTRUCTURE (BASEMENT)	CU.YDS.	330	15.00	
34	CONCRETE IN INTAKE AND OUTLET STRUCTURES	CU.YDS.	570	15.00	
35	CONCRETE IN SPILLWAY WEIR, SPILL- WAY LINING, RETAINING WALLS AND GROUTING CAP	CU.YDS.	6,000	10.00	
36	CONCRETE IN ROAD AND BRIDGE STRUCTURES	CU.YDS.	135	15.00	
37	FURNISHING, BENDING AND PLACING STEEL REINFORCEMENT	LB.	128,730	.04	
38	OPERATING HOUSE SUPERSTRUCTURE	JOB	-	10,000.00	
39	STEEL FOR ACCESS BRIDGE	LB.	80,000	.07	
40	FURNISHING AND INSTALLING GATES AND ACCESSORIES	JOB	-	40,000.00	

ITEM	DESIGNATION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
41	FURNISHING AND INSTALLING GASOLINE-ELECTRIC STANDBY UNIT	JOB	-	<u>5.00</u>	
42	FURNISHING AND ERECTING MISCELLANEOUS STRUCTURAL STEEL	LB.	22,000	<u>.68</u>	
43	FURNISHING AND INSTALLING MISCELLANEOUS IRON AND STEEL	LB.	6,200	<u>.68</u>	
44	FURNISHING AND INSTALLING MISCELLANEOUS WROUGHT IRON PIPE	LB.	2,500	<u>.10</u>	
45	FURNISHING AND INSTALLING MISCELLANEOUS BLACK STEEL PIPE	LB.	13,500	<u>.10</u>	
46	FURNISHING AND INSTALLING MISCELLANEOUS BRASS AND BRONZE	LB.	700	<u>.50</u>	
47	FURNISHING AND INSTALLING COPPER WATER STOPS	LB.	4,300	<u>.50</u>	
48	FURNISHING AND INSTALLING ELECTRIC LIGHT AND POWER SYSTEM	JOB	-	<u>10,000.00</u>	
49	FURNISHING AND ERECTING HIGHWAY CABLE GUARD RAIL - COMPLETE	LIN.FT.	700	<u>1.00</u>	
50	FURNISHING AND ERECTING CABLE GUARD FENCING - COMPLETE	LIN.FT.	1,300	<u>1.00</u>	
51	FURNISHING AND PLACING BITUMINOUS MACADAM ROAD SURFACE	SQ.YDS.	1,400	<u>1.20</u>	
52	FURNISHING AND INSTALLING GAGES - TILE AND STAFF	JOB	-	<u>1,000.00</u>	
53	FIELD OFFICE	JOB	-	<u>4,000.00</u>	
54	CLEANING UP	JOB	-	<u>10,000.00</u>	
TOTAL					<u>\$296,180.00</u>

NOTES: - (1) All amounts and totals stated above will be subject to verification by the Government. In case of variation between unit prices and amounts and totals stated by the bidder, the unit prices will be considered to be his bid.

(2) All bids must be for the entire work and must have each blank space filled.

(3) The quantities of each item of the bid as finally ascertained at the close of the contract, and the unit prices of the various items stated by the bidder in the accepted bid, will determine the total payments to accrue under the contract. The unit price bid for each item must allow for all collateral or indirect costs connected with it.

PLANT TO BE USED ON THE WORK.

(See Invitation for Bids and Paragraph 1-09 of the specifications.)

Note: - Use separate line for each major item.

No.	Name	Kind	Capacity	Age and Condition
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Excavation Equipment

Drilling Equipment

Concrete Equipment

Material Handling Equipment

No.	Name	Kind	Capacity	Age and Condition
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Pumping Equipment

Earth Embankment Equipment - Rolled Fill  
(Excavation and Transportation)

(Spreading and Rolling)

Rock Fill and Riprap Equipment

Gates and Accessories, Machinery

(The bidder shall submit catalogues and information showing all details or permanent equipment he proposes to install in the tunnel, gate shaft and operating house.)

No.	Name	Kind	Capacity	Age and Condition
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Miscellaneous Equipment

Experience. - (See Invitation for Bids)

DATA SHEET

SERVICE AND EMERGENCY GATES

Manufacturer's Name.

GATE HOISTS

Manufacturer's Name.

31.3 KVA GASOLINE-ELECTRIC GENERATOR UNIT

1. Engine: (Manufacturer) \_\_\_\_\_  
Type or Model Number: \_\_\_\_\_  
Number Cylinders: \_\_\_\_\_
2. Electric Generator: (Manufacturer): \_\_\_\_\_  
Type or Model Number: \_\_\_\_\_  
Rating: \_\_\_\_\_ K.V.A., \_\_\_\_\_ R.P.M., \_\_\_\_\_ PHASE \_\_\_\_\_ CYCLES \_\_\_\_\_  
POLES, \_\_\_\_\_ VOLTS, \_\_\_\_\_ AMPS., \_\_\_\_\_ P.F. (Lagging) \_\_\_\_\_

DATA SHEET

ELECTRIC SWITCHBOARD

Manufacturer \_\_\_\_\_

Type Construction \_\_\_\_\_

Overall Dimensions \_\_\_\_\_

Manufacturer      Type      Rating

Panel No. 1

Voltage Regulator -

Excitor Field Rheostat -

Voltmeter -

Voltmeter Selector Switch -

Line Ammeter (A.C.) -

Ammeter Selector Switch -

Field Ammeter (D.C.) -

Main Circuit Breaker -

Main Disconnecting Switch -

Panel No. 2

Hoist-Motor Feeder C.B.'s. -

Lighting Transformer Feeder C.B. -

Lighting Panel Feeder C.B. -

Battery Charger Feeder C.B. -

Battery Charging Ammeter -

Battery Charging Rectifier -

It is hereby warranted that in the event award is made to the undersigned there will be used in the performance of the work covered by the contract only such unmanufactured articles, materials, and supplies as have been mined or produced in the United States and only such manufactured articles, materials, and supplies as have been manufactured in the United States all from articles, materials, or supplies mined, produced or manufactured, as the case may be, in the United States, except as noted below or otherwise indicated in this bid or authorized in the specifications.

The undersigned agree, upon receipt of written notice of the acceptance of this bid within 60 days after the date of opening of the bids, to execute the standard form of Government contract, in accordance with the bid as accepted, and to give the required bonds with good and sufficient surety or sureties for the faithful performance of the contract and for the protection of all persons supplying labor and materials in the prosecution of the work, within 10 days after the prescribed forms are presented for signature.

Performance will begin within 10 calendar days after the receipt of notice to proceed and will be completed within 760 calendar days after date of receipt of said notice to proceed.

\_\_\_\_\_  
(Bidder)

\_\_\_\_\_  
(Address)

By

\_\_\_\_\_  
(Name)

\_\_\_\_\_  
(Title)

Note: - Read Standard Government Instructions to Bidders before preparing this bid.